AN ECOLOGICAL AND FLORISTIC ACCOUNT OF THE VEGETATION OF WESTFALIA ESTATE ON THE NORTHEASTERN-TRANSVAAL ESCARPMENT

by

JOHN CHRISTOPHER SCHEEPERS

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M.Sc.

PRETORIA.

May, 1966.

GRATEFULLY

DEDICATED

TO MY

PARENTS

PREFACE

The following account is based on the results of nearly four- and-a-half year's field work on Westfalia Estate near the village of Duiwelskloof in the Letaba District of the Northeastern Transvaal. The research began in January, 1958, when I was engaged to undertake a botanical survey of Westfalia Estate and to build up a herbarium, in terms of a bursary provided by the Hans Merensky Trust. The project was continued on this basis until February, 1960, when I was appointed to a post in the Botanical Survey Section of the Division of Botany, and allowed to complete the field work on the Estate.

The area investigated comprised the group of farms belonging to Westfalia Estate broadly outlined in the accompanying Map (see opposite p. 3) and amounting to some 7000 morgen (about 23 sq. miles). Those portions of the Estate lying to the east of the main Duiwelskloof-Tzaneen road were less intensively studied, because very little of the original vegetation remains unscathed, most of the area being under eucalypt plantations and citrus orchards or near to homesteads and kraals. Apart from the above area, numerous collections were made in the Grootbosch Government Forest Reserve on the upper (western) boundaries for continuity since high forest vegetation is not very well represented on the Estate. On occasion, excursions and collections were also made at lower altitudes over the boundaries of the Estate. These excursions, together with observations and collections made just within the boundaries contributed substantially to the better comprehension of the relationships between communities occurring on the Estate, and also between these and the surrounding vegetation types.

The specific aim of the botanical survey was to draw up as complete an account as practicable of the vegetation existing on Westfalia Estate, in order to lay the foundation for the better understanding and scientific utilisation of the vegetation. Such basic research will make possible further investigations into plant succession and related aspects of conservation farming such as nature conservation, soil reclamation and hydrological consequences of succession. In its wider context, this study is also intended to contribute towards a projected ecological survey of the forest areas of the Eastern-Transvaal Escarpment. Little thoroughgoing botanical investigation of this interesting area has, as yet, been attempted and few scientific accounts have been published.

Westfalia Estate and the neighbouring Woodbush area are of particular ecological and floristic interest in that they comprise the only remaining fairly representative and continuous segment of territory extending almost from the Lowveld plains up to the heights of the Escarpment in the Tzaneen-

Duiwelskloof region. This section of the Eastern Escarpment, represents the northernmost high-lying section until the Eastern Soutpansberg is reached.

The presence of outlying Southern and Tropical African elements adds to the phyteogeographic interest. This aspect has scarcely been touched.

At this stage, I wish to draw attention to and, perhaps, forestall possible criticism of the lengthy section devoted to climate. Plant-ecological research in this Escarpment situation inevitably entails a study of the parallel altitudinal changes in the vegetation and the environment, notably climate. Because climate is the decisive factor-complex determining the altitudinal zonation of vegetation, an attempt was made to correlate, where possible, the vegetation zones with climatic zones. Several climatic factors contributed individually to the pattern, e.g. rainfall, presence or absence of mist, liability to drought, and temperature. Although these factors contributed severally to the pattern of altitudinal zonation, it was felt that an attempt should be made, for all its shortcomings, to recognise and name climatological zones. This study is in its infancy but it is hoped that these halting steps may eventually contribute to visible progress in this field. If topographic patterns of vegetation and climate can be correlated with optimum utilisation of natural resources, notably soil and water, a great step forward will have been made. Work along these lines on the slopes of the Andes has continued for some time and some of the available indications for certain patterns of land use may also be applicable on the Eastern Escarpment of South Africa.

I am deeply grateful to persons, and public and private bodies, who have made it possible for me to begin, continue and complete this study.

To the Board of Trustees of the Hans Merensky Trust, including, at the time of the inception of this project, Dr. J.C. Fick, I owe a great debt of gratitude for generous financial assistance and for the facilities made available to me while engaged on field work at Westfalia Estate. No less am I indebted to them for the privilege of being able to work on a project in a field which was practically untouched and has revealed several interesting lines of enquiry. My sincere thanks are, especially, due to Dr. J.D.M. Keet, Resident Director of Westfalia Estate and ex-Director of the Union Department of Forestry, from whose kind and well-informed advice, encouragement, and direct assistance, I have benefited immeasurably. His keen interest has ever been and remains an inspiration to me.

I wish to record my grateful thanks to Prof. H.P. van der Schijff, Head of the Department of General Botany at the University of Pretoria, under whose direction this study was undertaken, for his sustained interest and guidance, unstinted encouragement and valuable criticism. To Prof. H.G. Schweickerdt (retired), I am deeply grateful for his unfailing interest, encouragement and advice.

To the Chief of the Botanical Research Institute, Dr. L.E.W. Codd, and to his predecessor, Dr. R.A. Dyer, I owe especial thanks for being allowed to continue working on this project after appointment to the Institute. I am, moreover, indebted to them for their continued personal interest and assistance, as well as for making the facilities of the National Herbarium available to me from the earliest days of the project. For their ever gracious and ready help with the identification of specimens and in other ways I am most grateful to my present and former colleagues at the Institute. I owe a special word of thanks to Dr. D.J.B. Killick for his valuable advice and criticism.

My grateful thanks are also due to the Department of Agricultural Technical Services for allowing the completion of this survey as an official project and for permission to use the results for thesis purposes.

I am indebted to Dr. H.C. von Christen and Dr. R. F. Loxton, both formerly of the Soils Research Institute, for their generous assistance in the preparation of the section dealing with soils.

I would like to express my warm appreciation of the kindness shown to me by Prof. T.W. Gevers, Head of the Department of Geology at the University of the Witwatersrand, in permitting me to make use of certain of his photographs and for the benefit of his first-hand knowledge of the geology and several facets of the historical background of Westfalia Estate.

Sincere thanks are extended to the staff of Westfalia Estate, past and present, for their assistance in kind in manifold ways too numerous to detail here. I am also much indebted to the many people whom I interviewed in search of historical and other information. Personal communications by these people are acknowledged in the text, where their names are given followed by the abbreviation "p.c.".

To Mrs. M.M. Gouws, I am very grateful for the arduous task of typing the manuscript.

Thanks are due to Mr. I.J.D. van der Westhuizen for his work in printing the photographs and to his wife for her help. The illustrations represent my own work with the exceptions of the photographs taken by Prof. T.W. Gevers, and of Fig. 1 and Plates 2(a) and 2(b), for the reproduction of which I am indebted to the Government Printer and the Trigonometrical Survey Office.

Finally, I wish to record my heartfelt gratitude towards my parents for the invaluable opportunities of undergraduate and postgraduate study made available to me, and for their implicit confidence and sustained encouragement over the years.

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CHAPTER 1

INTRODUCTION

A. HISTORICAL BACKGROUND

The history of Westfalia Estate can be divided into two periods. The first period can be considered to have ended in 1929 when Dr. Hans Merensky purchased the Estate. The second period extends from the 1930's to the present day.

1. THE HISTORY OF WESTFALIA ESTATE AND VICINITY UNTIL 1929

Prehistoric man, the Bushmen and other nomads, who were presumably to be found in the area at various times, have left no trace in the immediate neighbourhood of Westfalia Estate. The first settled human occupation recorded was by the Sepedi-(North Sotho-)speaking Bantu tribes of the Sotho-Chuana ethnic group.

The forebears of the present Balobedu tribe appear to have been established in the vicinity of the present Modjadji Location near Duiwelskloof as from the 17th century (Krige & Krige, 1943). By 1800 they had become a minor tribe, secure in their mountain fastness and isolated by malaria and nagana. In the basin to the southwest of Modjadji's realm, several petty tribes were scattered in small villages, whose chieftains were considered to be subordinate to Modjadji.

After the Great Trek, several trekboers, ivory hunters and other nomadic White people were to be found in the Northern Transvaal. Eventually the village of Schoemansdal was founded in the late 1840's and the Zoutpansberg district was proclaimed soon afterwards (Bulpin, 1952; Grimsehl, Unpubl.; Kruger, Unpubl.).

With their genial climate, the upper levels of the Northeastern-Transvaal Escarpment were settled by Europeans well before the end of the last century (King, 1941). The upper Escarpment appears to have been rather sparsely settled in the seventies by almost self-supporting White farmers, and woodcutters (King, 1941; Lane-Poole, 1909; W.M. Botha, p.c.).

At first, the Europeans used the slopes and foothills of the Escarpment for early spring grazing and for routes down to the fever-ridden Lowveld for winter hunting expeditions. At a later stage Europeans settled on the malaria-free upper levels of the foothills and slopes. The first European resident on the foothills near present-day Duiwelskloof was the Rev. F. Reuter of the Medingen Mission Station, which was founded in 1881 (Grimsehl, Unpubl.).

To consolidate its claim to the Zoutpansberg district as a part of the Z.A. Republiek, the Government of the day sought to encourage settlement in the unhealthy areas by providing farms for occupation free of charge. Nevertheless, settlement was initially rather slow until the middle nineties by which time almost all the farms were occupied (Rev. W. Krause, p.c.).

As the highlands became more densely occupied, European settlement began to extend to lower altitudes. Among the early settlers in the low-lying parts was the pioneer partnership of Altenroxel and Plange who settled on Krabbefontein, near present-day Tzaneen in the early 1890's (Mrs. Augusté Altenroxel, p.c.; W.M. Botha, p.c.; Rev. W. Krause, p.c.; W. Plange, p.c.). In 1899 Altenroxel and Plange bought the farm Bukhannie which was renamed Westfalia. They also purchased the neighbouring farms of Sarahsdrift, Schoenklip, Morgenzon, Prinsloosrust, Waterval and Fredericksdal and farmed them as a unit (Mrs. Augusté Altenroxel, p.c.; W.M. Botha, p.c.; J.C. Fick, p.c.; Mrs. Dora Graham, p.c.; J.D.M. Keet, p.c.; W. Plange, p.c.; P.C. Smit, p.c.).

This group of farms, which became known as Westfalia Estate, was later purchased by Sir Lionel Phillips who presented them to his son, Harold. In 1914, portions of Boschhoek and Vlakhoek were added to the Estate, as were also, subsequently, the farms Groenfontein, Pisangkop* and Rosendal and a further portion of Boschhoek (see Map, p. 3).

In the twenties, some of the more low-lying of these farms were cut up for sale to British settlers who had come out to South Africa under the auspices of the 1820 Memorial Settlers Association (J.A. Brown, p.c.). A number of settlers were also induced to come from Germany (W. Plange, p.c.). After the death of his son, Sir Lionel Phillips considered disposing of the remainder of the Estate but he was keenly aware of the necessity for conserving the mountain slope and foothill catchment areas for posterity. After negotiations with the Department of Forestry of the Union Government, for the purchase of the upper slopes, had fallen through, the entire Estate was bought

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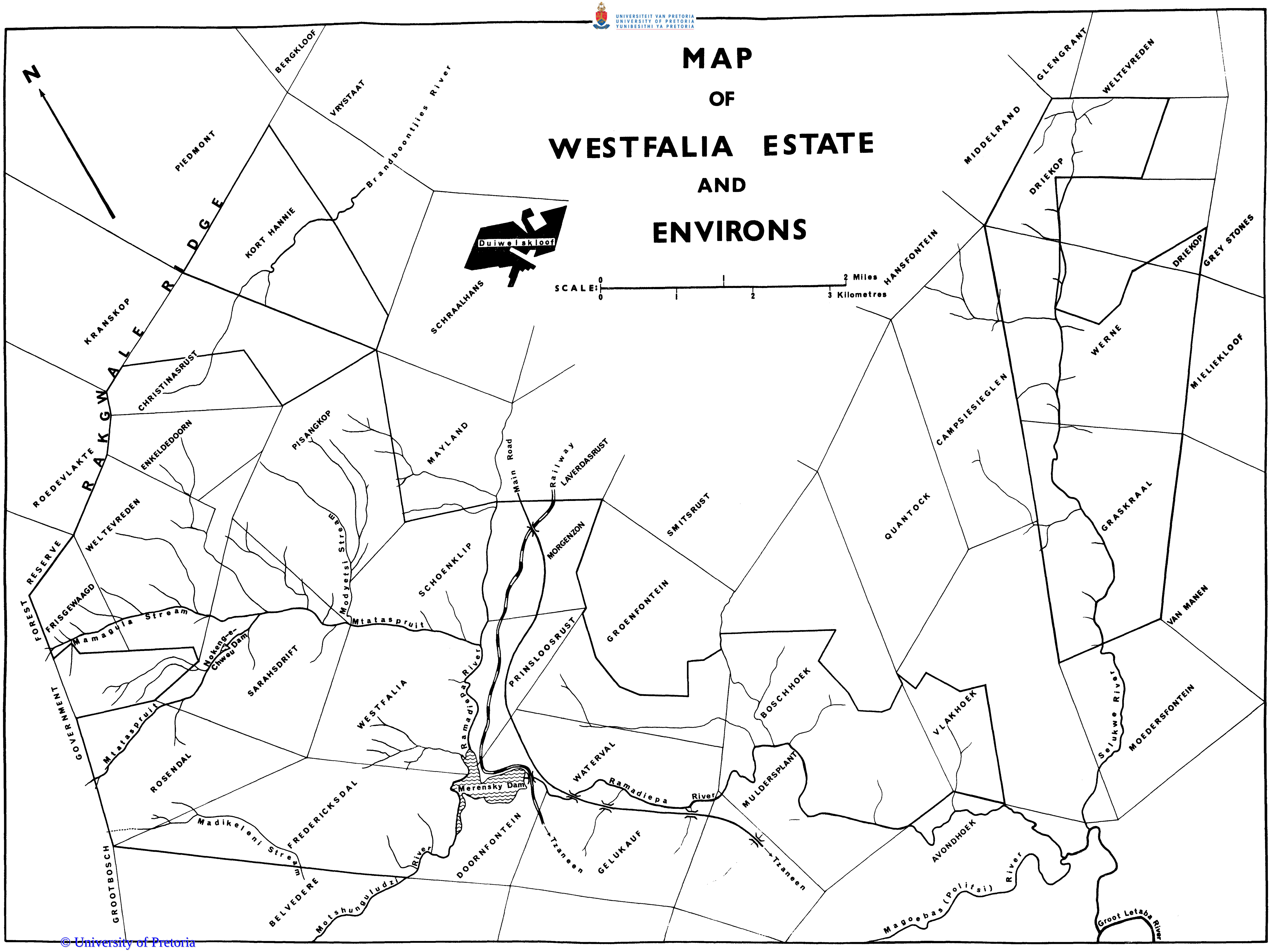
* Henceforward, the spelling "Piesang Kop" will be used to denote the hill or mountain of that name. The spelling "Pisangkop" will only be used with reference to the farm of that name.


MAP
OF
WESTFALIA ESTATE
AND
ENVIRONS
SCALE:
0 1 2 Miles
0 1 2 3 Kilometres
N
Duiwelskloof
RAKGWALE RIDGE
BERGKLOOF
VRYSTAAT
Brandboontjies River
PIEDMONT
KORT HANNIE
KRANSKOP
SCHRAALHANS
CHRISTINASRUST
PISANGKOP
MAYLAND
ENKELDEDOORN
ROEDEVLAKTE
WELTEVREDEN
FOREST RESERVE
FRISGEWAAGD
Mamagula Stream
Mtataspruit
Modyetsi Stream
Nokeng-e-Chweu Dam
SARAHSDRIFT
SCHOENKLIP
Main Road
Railway
LAVERDASRUST
MORGENZON
SMITSRUST
GROENFONTEIN
PRINSLOOSRUST
WESTFALIA
Ramadiepa River
GOVERNMENT
ROSENDAL
Merensky Dam
FREDERICKSDAL
Madikeleni Stream
Motshunguludzi River
BELVEDERE
GROOTBOSCH
DOORNFONTEIN
Tzaneen
WATERVAL
GELUKAUF
Ramadiepa River
MULDERSPLANT
BOSCHHOEK
QUANTOCK
HANSFONTEIN
CAMPSIESIEGLEN
VLAKHOEK
AVONDHOEK
Magoebas (Polifsi) River
MIDDELRAND
GLENGRANT
WELTEVREDEN
DRIEKOP
DRIEKOP
GREY STONES
WERNE
MIELIEKLOOF
GRASKRAAL
VAN MANEN
Selukwe River
MOEDERSFONTEIN
Groot Letaba River

Hennie's/Pta.

in 1929 by Dr. Hans Merensky, known to be interested in the conservation of natural resources (Lehmann, 1959; J.D.M. Keet, p.c.).

2. THE HISTORY OF WESTFALIA ESTATE SINCE 1929

When Dr. Merensky purchased Westfalia Estate, it consisted of the farms Westfalia, Fredericksdal, Rosendal, Sarahsdrift, Pisangkop and Schoenklip, and portions of Morgenzon, Prinsloosrust and Waterval. Graskraal was subsequently added as well as portions of Groenfontein, Vlakhoek, Boschhoek, Driekop, Uitkyk(Werne), Enkeldedoorn, Christinasrust and Kort Hannie.

Meanwhile a sustained campaign was being waged against malaria, the main hindrance to the development of the area since the completion of the Selati Line, linking Komatipoort and Pietersburg, in 1914. By 1947, malaria had been practically eradicated, thanks to the efforts of the late Dr. S. Annecke and his co-workers.

At the outbreak of the Second World War, Dr. Merensky retired to Westfalia, to which he gave his almost undivided attention during the remaining years of his life. He took a keen scientific interest in both the theoretical and practical aspects of farming and endeavoured to keep in touch with new developments. Conservation was the keynote of his farming policy. Having seen the results of some of his ideas being applied in practice, he felt that provision should be made for hydrological and other research work on a sound scientific basis, to promote conservation farming and serve the conservation ideal. It was with this end in view that he enjoined that such work be undertaken when, during the last years of his life, he formed the Hans Merensky Trust, which has administered his estate since his death in 1952. With the same objective in mind, provision was also made for the eventual conversion of the Trust to a Foundation. Since the formation of the Hans Merensky Trust, further property has been added to the Estate. The portion of the present extent of Westfalia Estate investigated can be seen in broad outline in the accompanying Map.

B. UTILISATION AND CONSERVATION OF NATURAL RESOURCES

Land utilisation in the region and on the Estate must be discussed against the foregoing historical background.

1. THE PERIOD BEFORE 1929

The natural veld is divisible into the following broad vegetation belts:

1. The High Forest Belt or North-Eastern Mountain Sourveld of Acocks (1953). This includes the upper Mistbelt levels of the Escarpment upwards of 1200 m above sea-level.
2. The Scrub Forest Belt of the upland zone of foothills and mountain slopes, extending from the High Forest Belt down to 900 m altitude.
3. The Savanna Woodland Belt or low-lying country below 900 m elevation. On Westfalia Estate this Belt is represented by a vegetation type transitional to the Lowveld Sour Bushveld of Acocks (1953).

1.1 THE HIGH FOREST BELT

Apart from its grazing, the North-Eastern Mountain Sourveld was at first largely utilised for its timber resources. The "Houtboschen" or Woodbush forests were first exploited by Transvaal and Orange Free State farmers as from the 1840's. Good waggon timber was especially prized. Sawyers settled around the forests, round about 1870, and set up a timber trade which was given impetus by the discovery of the Eastern Transvaal Goldfields in 1873. Prospectors and, later, miners likewise made inroads on the local forests. Thus began a period of forest exploitation which was further aggravated by the insatiable demand for timber on the rapidly developing Witwatersrand. Timber commanded good prices with the result that little communities sprang up at Houtboschdorp (c. 1890) and at Haenertsburg. These hamlets catered for the needs of the surrounding farmers, woodcutters, transport riders and others. Felling was mainly concentrated on good saw-log timber of *Olea capensis* subsp. *macrocarpa*, *Podocarpus* spp., *Cassipourea gerrardii*, *Curtisia dentata*, *Prunus africana*, *Rapanea melanophloeos* and *Syzygium gerrardii* (Hutchins, 1903; Lane-Poole, 1909; W.M. Botha, p.c.).

This heavy exploitation continued until the rail links from Port Elizabeth and East London to Johannesburg were completed in the late nineties. Timber for the Reef could then be brought by rail from the forests of the Ciskei and Border districts until these were depleted shortly before the inception of Union. By this time, the remaining usable timber was so inaccessible that it was usually cheaper and less troublesome to buy imported timber. The mines along the Escarpment in the Eastern and Northeastern Transvaal, however, continued to draw on the local indigenous timber resources but to an ever-decreasing extent (King, 1941; Lane-Poole, 1909; W.M. Botha, p.c.; J.D.M. Keet, p.c.).

On Westfalia Estate, as constituted before 1929, only slight damage was done to the limited amount of high forest. Some selective felling, especially of _Curtisia dentata_ and _Brachylaena transvaalensis_, is said to have taken place over many years at the hands of W. McDonald in the forests bordering Rosendal (see p. 147) and the neighbouring farms, especially Frisgewaagd and Weltevreden. Although the Bantu may have removed small timber and perhaps even cleared land along the margins, they appear to have caused little destruction to the patches of high forest.

The remaining high forest areas of the present Westfalia Estate and adjacent farms and Forest Reserve were too inaccessible to be heavily exploited by the early woodcutters (W.M. Botha, p.c.). After the completion of the railway line, however, the outlying strip of the "Grootbosch", which extended along the Rakgwale Ridge from Weltevreden to Kort Hannie, suffered much destruction from 1917 to 1918. As a result of a contract by B.S. Altenroxel with an agent supplying the Witwatersrand, almost all accessible merchantable timber was removed from the farms along the ridge, except on the farm Enkeldedoorn. The owner of this farm did not enter into the contract (Mrs. Augusté Altenroxel, p.c.; W.M. Botha, p.c.; P.C. Smit, p.c.). After the large-scale clearfelling of these forests, Bantu croplands encroached up the ridge from below at an alarming rate (W.M. Botha, p.c.; P.C. Smit, p.c.).

The Transvaal Department of Agriculture and Forestry established plantations on the Escarpment near Woodbush Forest Station in the early 1900's. Experimental plantings revealed that "saligna gum" (_Eucalyptus grandis_ and _E. saligna_) and some other eucalypts and various pines, such as _Pinus patula_ and _P. pseudostrobus_, were the most suitable species (J.D.M. Keet, p.c.). Afforestation with these trees continued for many years on the Escarpment and the foothills to the southeast of Woodbush.

Although plantations had been established on farms for many years previously for local consumption and windbreaks, the present Duiwelskloof area did not evince much interest in the growing of timber until after the completion of the rail link. Afforestation in the area was stimulated by the news that the pioneer Dicke had sold timber from eucalypt avenues at a handsome profit (Gevers, 1948).

The first eucalypt plantings of note on Westfalia appear to have been avenue plantings by C. Plange at about the turn of the century (Gevers, 1948). When the Duiwelskloof area first began growing timber for sale in the twenties, eucalypt plantations were also established on the Estate, especially below the High Forest Belt. Wattle plantations (mainly _Acacia mearnsii_ de Wild.) were also established below the Mistbelt but gummosis made this an unprofitable venture.

Grevillea robusta was planted as well but this, too, gave unsatisfactory results (A.E.G. Petersen, p.c.).

The sourveld of the higher altitudes of the Estate, notably of Fredericksdal, Rosendal and Pisangkop, and of the glades of the Grootbosch Government Forest Reserve, was used for stock farming during the twenties, especially for spring grazing (J.D.M. Keet, p.c.; W.E. Maddison, p.c.).

1.2 THE SCRUB FOREST BELT

The Bantu inhabitants of the Westfalia area were originally fairly widely scattered but somewhat more concentrated on the foothills and lower mountain slopes between the periodically cold, damp and misty high-forest levels of the Mistbelt and the hotter, drier and less healthy parts of the low-lying savanna woodland country. They had a preference for building their huts on eminences for health and also, possibly, aesthetic reasons, as well as for security against surprise. This tendency to settle in the Scrub Forest Belt was probably intensified by the White settlement of the cooler High Forest Belt and the European cultivation of the more level arable land of the Savanna Woodland Belt at lower levels.

The Bantu raised crops by shifting cultivation necessitating periodic bush-clearing. Much timber was cut for palisades and for hut-building. Poles of Faurea saligna, Pterocarpus angolensis, Terminalia sericea and Trema orientalis, inter alia, were favoured among the trees of the lower altitudes, while Brachylaena transvaalensis, Curtisia dentata, Cassipourea gerrardii and several other trees were cut at higher elevations (Keet, 1962 & p.c.; W.M. Botha, p.c.; S.C. McDonald, p.c.). It would appear that a great deal of Acacia ataxacantha was cut for scrub fences or "skerms". Long shoots or "canes" were split and used in basketry. Strips of bark of various trees were removed for medicinal purposes, causing various degrees of dying back and coppicing. The regeneration of certain species was adversely affected by the removal of poles and saplings for hafts, laths, staffs, withes and sticks. It seems that in the course of clearing land for cultivation, Acacia ataxacantha and other stumps were incompletely removed, the remaining portions coppicing more or less freely, depending on the species. For the sake of its shade and its edible fruit, Parinari curatellifolia subsp. mobola was often left standing in cultivated lands, which became liberally bestrewn with seed (W.M. Botha, p.c.). The activities of the Bantu were thus variously detrimental or favourable for the regeneration of different species.

To provide sufficient fresh grazing, the veld was often fired. Many fires got out of hand through the clearing of "mataka"-lands, i.e. crop-lands in marshy areas, especially in the valley-bottoms of the low-lying parts. This Bantu practice involved the burning of the marsh vegetation in late winter or early spring to clear the wet soil for planting to crops for early harvests secure against drought (Gevers, 1948; W. Plange, p.c.). Veld was also burned to drive bush pig away from the vicinity of crop-lands (W.E. Maddison, p.c.), while the practice of smoking out wild bees when robbing hives resulted in many fires. Before a coöperative system of firefighting and making firebreaks came into being, extensive damage was often caused by fires resulting from the above practices, as well as those starting from the railway (Mrs. Dora Graham, p.c.; W. Plange, p.c.).

1.3 THE SAVANNA WOODLAND BELT

In the early days, the natural veld below 900 m altitude is reputed to have been a tall grass savanna of "tambookie grasses" (*Cymbopogon validus* and *Hyparrhenia* spp., notably *H. cymbaria*, *H. dissoluta* and *H. glauca*), 2 m to 3 m or more tall, with scattered trees, shrubs and scramblers, sometimes aggregated into bush clumps. Typical associated plants included *Parinari curatellifolia* subsp. *mobola*, *Pterocarpus* spp., *Faurea* spp., *Rubus pinnatus*, *Smilax kraussiana*, *Mucuna coriacea*, *Bauhinia galpinii* and *B. kirkii*, as well as some species that have now virtually disappeared from the Estate, such as *Albizia versicolor*, *Combretum suluense*, *Ehretia amoena*, *Ficus burkei*, *F. petersii* and *F. sycomorus*, *Piliostigma thonningii*, *Pterolobium exosum*, *Sclerocarya birrea*, *Steganotaenia araliacea*, *Terminalia sericea*, *Vernonia colorata* and *V. crataegifolia* (Mrs. Dora Graham, p.c.; A.E.G. Petersen, p.c.; P.C. Smit, p.c.).

The grass was, as a rule, very rank and unpalatable for grazing, except for a short while after being burned. The timber resources were little utilised at first, except for limited domestic use. After the Anglo-Boer War, however, larger quantities of the more valuable timber trees such as *Pterocarpus angolensis* ("Kiaat") and *Adina microcephala* var. *galpinii* ("Matumie" or "Mingerhout") were removed wherever sufficiently accessible (W.M. Botha, p.c., A.H.F. Geyer, p.c.; J.D.M. Keet, p.c.).

In the early pioneer days, the low-lying parts of Westfalia Estate were chiefly tilled for crops. As a result of unscientific farming, these crop-lands were short-lived. Sustained yields of maize, groundnuts and cotton could not be obtained. Tobacco was grown from about the turn of the century, but it ceased to be a paying proposition after some five or six years. This cropping led to extensive erosion with, frequently, spectacular donga formation on the steeply rolling countryside (cf. Van der Merwe, 1940; Read, 1941; J.D.M. Keet, p.c.; A.E.G. Petersen, p.c.; W. Plange, p.c.).

Pineapples were also grown on a small scale, the pineapple lands on Westfalia being replaced mainly by citrus orchards in the early twenties (A.E.G. Petersen, p.c.). Prior to this, orchards and vegetable gardens in this and the previously mentioned zones were normally small and planted mainly for household consumption. Large-scale coffee-planting by Altenroxel and Plange at Tzaneen Estate (Krabbefontein) and Westfalia Estate was ruined by coffee-rust (Mrs. Augusté Altenroxel, p.c.; cf. Charter, 1909).

Seen in the light of present-day ideas, much of the utilisation of the land and its resources in the foregoing three belts, during the first three decades of this century, would be regarded as improvident exploitation. It must be borne in mind, however, that methods of obtaining sustained yields under the conditions prevailing locally were unknown.

2. THE PERIOD AFTER 1929

2.1 LAND UTILISATION

The advent of the thirties heralded far-reaching changes in the pattern of land utilisation. At about this time forestry in the Duiwelskloof area came into its own. "General planting up of the area began about 1931-32 and lasted up to about 1940" (Gevers, 1948). By far the greater proportion of these plantings was of saligna gum.

Numerous plantations were established on Westfalia Estate during this period and a forestry policy was worked out with the collaboration of the late Prof. E.J. Neethling of the Department of Forestry at the University of Stellenbosch. Dr. Merensky was particularly interested in growing timber of saw-log dimensions and in promoting the use of saligna gum for furnishing. This has remained the policy under the administration of the Hans Merensky Trust (J.D.M. Keet, p.c.).

In the thirties many avocado trees and granadillas were planted. No additions were made to the citrus orchards until the last decade of Merensky's life. Under the direction of the Hans Merensky Trust, the citrus orchards have been greatly expanded. The low-lying avocado orchards were replanted to citrus under irrigation and new orchards of budded avocado trees were established at higher altitudes. The acreage under avocado trees has remained much the same, however. Through more thorough and efficient use of water resources, the extent of the citrus orchards has been more than doubled and is still being increased.

During the thirties, cattle were still being grazed in the High Forest Belt, on the upper Rosendal-Fredericksdal glade which was often burned. A portion of the top end of the glade was planted to potatoes and maize from 1933 to 1937, when these crop-lands were abandoned owing to impoverishment and erosion of the soil (W.E. Maddison, p.c.).

From 1946, the low-lying sandy valley-bottom on the Fredericksdal side of the Motshunguludzi River was made available to the Bantu for crops in order to draw them away from the hillslopes. After a decade of patchwork cropping, the soil was quite exhausted (W.E. Maddison, p.c.).

Even before World War II, Dr. Merensky was prompted to run a dairy herd, despite the prevailing opinion that stock-farming was not a worthwhile venture in the area. Cattle that had been introduced usually did not thrive on the available sourveld pastures and usually fell prey to various diseases against which they had no immunity. Nevertheless, Merensky determined to go ahead with his plan for two main reasons:

1. To introduce the animal factor into his soil-improvement programme, and
2. To provide milk for the Estate and the vicinity, where milk had hitherto been scarce (J.C. Fick, p.c.).

Because of the unpalatability of the natural sourveld pastures and the difficulties experienced in finding grasses and legumes suitable for planted pastures in this locality, trial plantings of potential pasture and fodder plants were started (see C. RESEARCH WORK: p. 11).

2.2 CONSERVATION WORK

After retiring to Westfalia at the outbreak of World War II, Dr. Merensky embarked on a large-scale conservation programme. The first step in conserving and building up the soil on the Estate was to deal with the large Bantu population, which was fairly widely scattered but with some concentration on the foothills. Kraals were shifted from the more vulnerable localities and at the same time, an attempt was made to reduce the overall Bantu population. Only permanent wage-earners and their families were allowed to remain on the Estate. Veldburning and the cutting of trees were forbidden. Dead wood could be cut for fuel but timber for hut construction was to be provided from the plantations. The numbers of livestock were also reduced. After the headmen had agreed that lobola be paid in cash thenceforward, all the cattle were bought by Dr. Merensky, most of which he sold forthwith (Lehmann, 1959; J.D.M. Keet, p.c.).

As the country became more soil-conservation conscious, Dr. Merensky was in the forefront of such work in the district. Apart from structural conservation measures, intensive efforts were made to improve impoverished soils by means of heavy applications of compost and manure. Compost was produced on a large scale from specially grown <u>Pennisetum purpureum</u>, trash and other vegetable matter, some of which was incorporated with kraal manure (Lehmann, 1959; J.C. Fick, p.c.; J.D.M. Keet, p.c.; S.C. McDonald, p.c.; W.E. Maddison, p.c.).

The planting of eucalypts continued, timber of saw-log size being grown in preference to mining timber. It was felt that silviculture on this basis was more conducive to soil and water conservation than timber-growing on a short rotation (Lehmann, 1959; J.D.M. Keet, p.c.). Dr. Merensky was, moreover, of the opinion that, besides retaining the soil, eucalypt plantations improve not only the physical but also the chemical properties of soils. He believed that deeply-penetrating roots take up plant nutrients from the subsoil which are eventually returned to the topsoil with the decay of litter and the upper roots. Afforestation formed an integral part of the soil-improvement programme especially on abandoned crop-lands on the low-lying portions (see discussion, p. 269 <u>et seq</u>.).

It is reported that, as a result of the above measures both the soil and soil-water relations improved and streamflow was increased and stabilised (Lehmann, 1959).

At about this time, however, the region began to suffer from a shortage of water and there was a fairly widespread belief that supplies were dwindling. Some of the interested parties attributed the shortage of water to afforestation of the mountain catchment areas but this contention was denied by plantation owners. The dispute became more heated and was at its height from shortly before the end of the war, lasting to the immediate post-war years. Merensky followed the controversy with interest and, concerned lest his plantations might be contributing to a general decrease in stream flow, he sponsored an investigation into the position in the Duiwelskloof area (see below, p. 12).

Because of the possible desiccating influence of eucalypt plantations, Merensky tried afforestation with <u>Trema orientalis</u> on the Estate with several aims in view though the main considerations were the simultaneous conservation and improvement of soil and water resources combined with timber production. Other indigenous trees were also planted as part of this project. However, because it was neither planned nor managed on a sound ecological basis, very little success was achieved and the project was a conspicuous failure from the point of view of timber production (see Chapter VIII, p. 251 *et seq.*).

C. RESEARCH WORK

Little research relevant to land utilisation and plant ecology has been carried out in the Duiwelskloof region.

The first experimental plantings of a large variety of fruit trees, coffee, cotton, tobacco and other crops were made in the 1890's on Krabbefontein by Altenroxel and Plange (Mrs. Augusté Altenroxel, p.c.). After this, the only noteworthy research of this nature was carried out by the Transvaal and, later, the Union Departments of Agriculture and Forestry on the same site, at Tzaneen Estate. This station closed down during World War I. Although very promising results were obtained with many plants, the lack of a railway remained a handicap until 1914.

The experimental plantings of pasture and fodder plants on Westfalia began in a very modest way but were subsequently expanded as a result of the active collaboration of the first Chief of the Division of Plant Industry, Dr. I.B. Pole Evans, and of the late C.J.J. van Rensburg, of the Division of Soil Conservation. These Divisions regularly supplied material of new and promising grasses and legumes for trial. Trial plantings continued until 1960. Numerous valuable pasture plants were recognised and planted out on a larger scale. The most promising results were achieved with species, strains and hybrids of the following genera: *Cynodon*, *Digitaria*, *Eragrostis*, *Lolium*, *Panicum*, *Paspalum*, *Pennisetum*, *Phalaris*, *Setaria*, *Glycine* and *Trifolium*, to mention but a few. Varieties of *Pennisetum purpureum* ("Napier fodder") gave the best all-round results. *Pennisetum purpureum* proved to be eminently well suited to the climate and it was extensively planted for green fodder and silage, as well as for erosion control and compost production (Lehmann, 1959; J.C. Fick, p.c.; J.D.M. Keet, p.c.; W.E. Maddison, p.c.; A.E.G. Petersen, p.c.).

With regard to forestry, it has been mentioned that the Transvaal Government started experimental plantings at Woodbush in the early years of this century in an effort to find the most suitable species for afforestation. The records of height and diameter increments over the years of *Eucalyptus grandis* in permanent sample areas can be numbered amongst the first accumulations of basic information on Westfalia Estate. A compartment was also tested for yields under the short rotation system. These data have proved of value to the Forestry Department of the Estate (J.D.M. Keet, p.c.), which has also recently collaborated with the Department of Forestry in a silvicultural research project at Boschhoek (Poynton, 1965). Other recent research undertaken by the Department of Forestry in the vicinity includes work on methods of soil preparation and tree breeding at Zomerkomst, near Politsi (Nel, 1965; Poynton, 1965).

As a result of the afforestation-desiccation controversy and stimulating papers by Gevers (1948) and Wicht (1949), the Hans Merensky Trust decided to initiate a hydrological research project in the catchment area of the Madikeleni Stream in upper Rosendal-Fredericksdal. This research was intended to supplement the work being done at Jonkershoek, Cape, and Cathedral Peak, Natal, (Lehmann, 1959; Nänni, 1956; J.D.M. Keet, p.c.). Owing to various practical difficulties, the initial experimental layout was later abandoned. This project is, at present, proceeding as an investigation into the relationships between rainfall and streamflow in catchments under conditions of complete protection, after withdrawal from conditions of occupation, cultivation and grazing (J.D.M. Keet, p.c.).

The only other relevant basic research carried out locally appears to be the geological surveys in the region by Hall (1914) and Mellor (1907), and the reconnaisance soil survey of Westfalia Estate undertaken by the Division of Chemical Services in 1961. Biological collections and observations have been made but only in a desultory fashion.

Apart from intermittent collecting trips by a large number of casual collectors, little consistent work on the flora of this area of the Northeastern Transvaal Escarpment and vicinity has been done since Rehmann (Szyszylowicz, 1887 & 1888) and Nelson, in the late seventies, and Schlechter, in 1894, first collected in the Houtbosch area. Of those who collected on the Escarpment foothills and adjacent Lowveld, mention must be made of Isobel McCallum in the New Agatha area, near Tzaneen, and of the Rev. H. Junod in the vicinity of the Swiss Mission at Shiluvane, near Leydsdorp. Well-known collectors such as E.E. Galpin, the Ven. F.A. Rogers, J. Burtt Davy, A.O.D. Mogg, Prof. and Mrs. C.E. Moss, E.P. Phillips and many others have collected in the region from time to time. Foresters W.M. Botha and J.A. O'Connor deserve special mention for their intimate knowledge of the forests of this area. J.D. Krige collected many plant specimens and ascertained their vernacular names and the folk-lore connected with them, among the Balobedu people of the Modjadji Location.

Of the various people who have collected on Westfalia Estate, J.D.M. Keet must be mentioned, since the greater number of the specimens collected by him on the Estate have been mounted and filed to form the nucleus of the Westfalia Herbarium.

In the course of the present investigation, nearly 1250 numbers were collected representing 162 families, 592 genera and 1057 species (indigenous). A complete check-list of species collected appears in Appendix B. Owing to lack of time, only the more common and most conspicuous species of the rich variety of Bryophytes were collected while Thallophytes were only collected where they were very conspicuous or were playing an important rôle in the succession. An almost complete set of specimens was set aside for the Westfalia Herbarium. Duplicate sets are kept in the University of Pretoria Herbarium and the National Herbarium, Pretoria, whence numerous duplicate specimens have also been distributed.

From the foregoing account, it is evident that land utilisation has, perforce, never been planned on an ecological basis. Development proceeded by trial and error, often resulting in wasteful exploitation of natural resources that has necessitated resolute conservation measures. This situation was inevitable because of a conspicuous dearth of basic knowledge. Only recently have there been signs that this deficiency is being rectified. It is hoped that this study will contribute not merely to academic knowledge but also towards a better understanding of the relationships existing between the vegetation and the environment - an understanding which should form the basis of scientific farming and wise utilisation of natural resources.

Before describing the vegetation, it will be necessary to discuss the environmental factors influencing the vegetation.

CHAPTER II

ENVIRONMENTAL CONDITIONS INFLUENCING THE VEGETATION

A. PHYSICAL FACTORS

1. GEOLOGY AND TOPOGRAPHY

Westfalia Estate is situated near to the village of Duiwelskloof in the Letaba District of the Northeastern Transvaal. It lies on the slopes of the Great Eastern Escarpment of South Africa to the south and east of the Woodbush-Rakgwale Ridge spur complex which forms the watershed between the Groot Letaba and the Koedoes(or Mokeetsi)-Middel Letaba River Systems. The Estate extends from the high ground of this spur complex (about 1400 m altitude) on the west and north down to about the 750 m levels grading into the Lowveld plain to the east. It consists of the following broad topographic belts:

1. The slightly to steeply sloping Montane Belt of the upper mountain slopes above about 1200 m in elevation
2. The steeply sloping much-dissected Foothill Belt of the foothills and lower mountain slopes
3. The gently sloping Lowlands below the 900 m levels.

The configuration of the land forms in this area is determined by the underlying geological structure. However, no detailed geological studies have, as yet, been undertaken in the vicinity of Duiwelskloof. General references to the region are to be found in accounts of the geology of nearby areas.

The area under consideration is mainly underlain by Archaean granite-gneiss (Du Toit, 1954). "Commonly there is a more or less intimate association between granite and gneiss and apparently a gradual transition from one into the other takes place" (Hall, 1914).

According to Von Christen (Unpubl.) and Gevers (p.c.), the majority of "granites" are of the Nelspruit type, i.e. coarse to medium-grained biotite-bearing Archaean granite-gneiss (see Visser & Verwoerd, 1960), and play an important part in the structure of the country. The granites and the less gneissic, more massive granite-gneisses with a lower content of ferromagnesian minerals, weather more slowly than the more foliated rocks and their local predominance is responsible

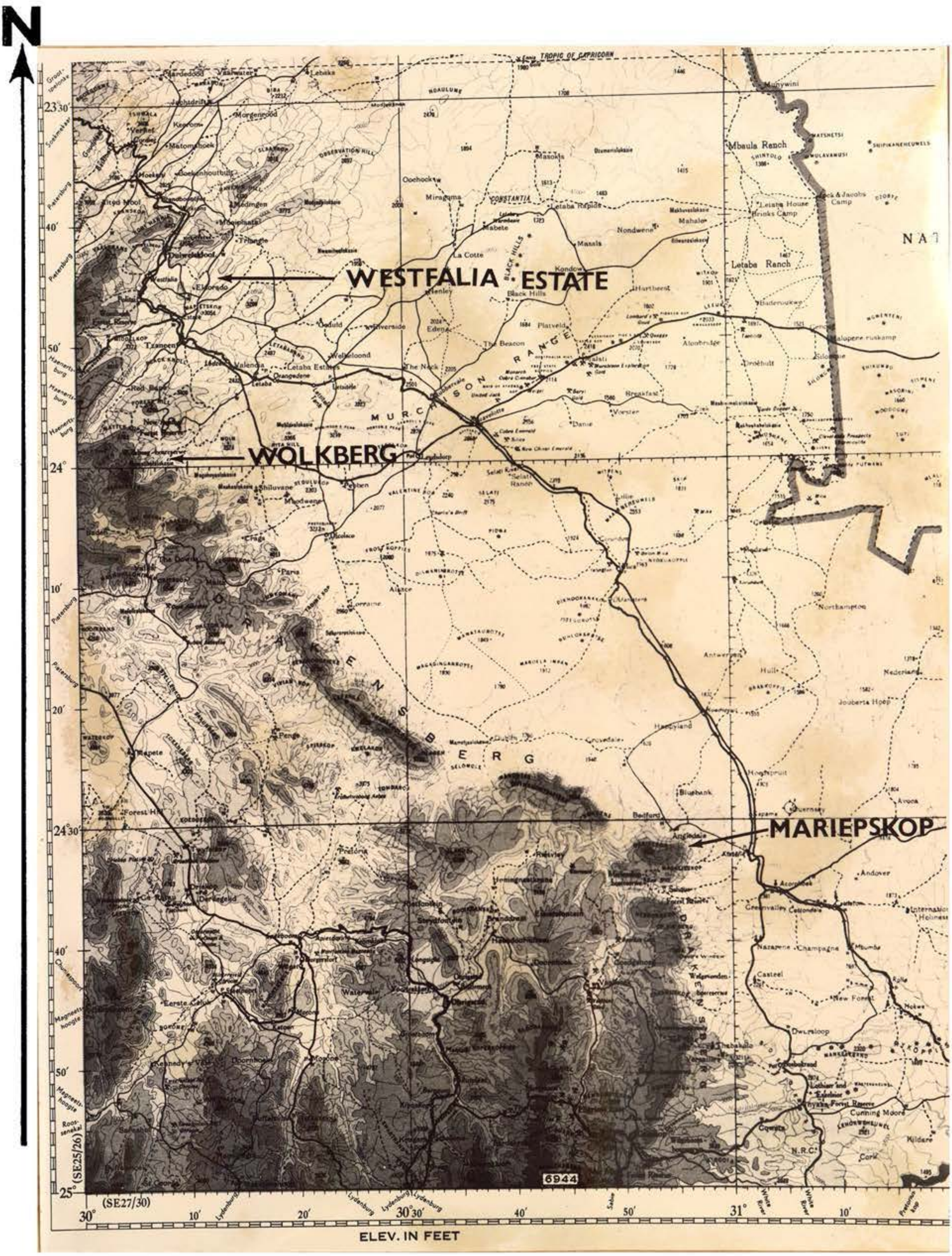


Fig. 1. Topographical map of part of the Eastern Transvaal, including Westfalia Estate, to indicate the north-south trend of the Drakensberg Escarpment south of the Mariepskop massif and the southeasterly-northwesterly trend northwards to the Wolkberg massif, with southwesterly-northeasterly orientated spurs to the north. The Tropic of Capricorn is indicated by the broken line at the upper (northern) margin.

for such conspicuous features in the landscape as Piesang Kop and the Central Hill (Mellor, 1907; T.W. Gevers, p.c.).

These granite-gneisses enclose xenoliths of the Primitive or Basement Systems. Such xenoliths may be readily recognised at higher altitudes, e.g. in the Iron Crown and Woodbush Mountains near Haenertsburg and Woodbush, extending to the edge of the Great Escarpment, along the boundary of the Grootbosch Government Forest Reserve adjoining Westfalia Estate. The Rakgwale Ridge, along the northern to northwestern boundaries of Weltevreden, Enkeldedoorn, Christinasrust and Kort Hannie, contains the longest strip of these schistose xenoliths on the Estate. Greatly weathered schistose xenoliths also occur at lower altitudes, according to Gevers (p.c.) and Von Christen (Unpubl.).

The foregoing older rocks are traversed by numerous basic dykes mostly of diabase, usually trending from due north to northeast (Gevers, 1948; Taljaard, 1938).

Where it is capped by resistant rocks, such as Black Reef Quartzites, the Great Escarpment is high with conspicuous scarps - as in the so-called "Drakensberg Phase" of the Eastern Transvaal Escarpment (see Taljaard, 1938: p. 13). The so-called "Plateau Phase" (ibid.), i.e. the northern tract, of the Eastern Transvaal Escarpment owes its low gentle nature mainly to its derivation from more readily weatherable granite-gneiss bedrock (King, 1951).

In the area investigated, the Great Escarpment is fretted to denticulated, lacking the cap of quartzites of the Wolkberg or Black Reef Series, which swing abruptly westwards at Letaba Point. After running northwards from the south to Mariepskop, the Escarpment as a whole bends away in a westerly to northwesterly direction until the Groot Letaba River is reached, where it again swings sharply away to the north (see Fig. 1). Spurs extending northeastwards from the Great Escarpment, especially from the plateau phase, form wide embayments. The large spur complex of the Rakgwale Ridge (including Piesang Kop) and the Duiwelskloof Ridge (Dickesberg), Ravenshill and Modjadji's Location, extending northeastwards from the western to northwestern boundaries of Westfalia Estate, forms the northwestern border of the basin formed by the upper northern tributaries of the Groot Letaba River.

One of the striking features of the relief of the region is the southwesterly-northeasterly trend of nearly all the spurs and ranges of foothills, as also of the courses of the main streams, especially of the Groot Letaba, Motshunguludzi, Upper Ramadiepa, Brandboontjies, Selukwe (Shellock), upper Nwanetsi, Molototsi, Koedoes and Middel Letaba Rivers (see Fig. 2). This direction corresponds to and is a

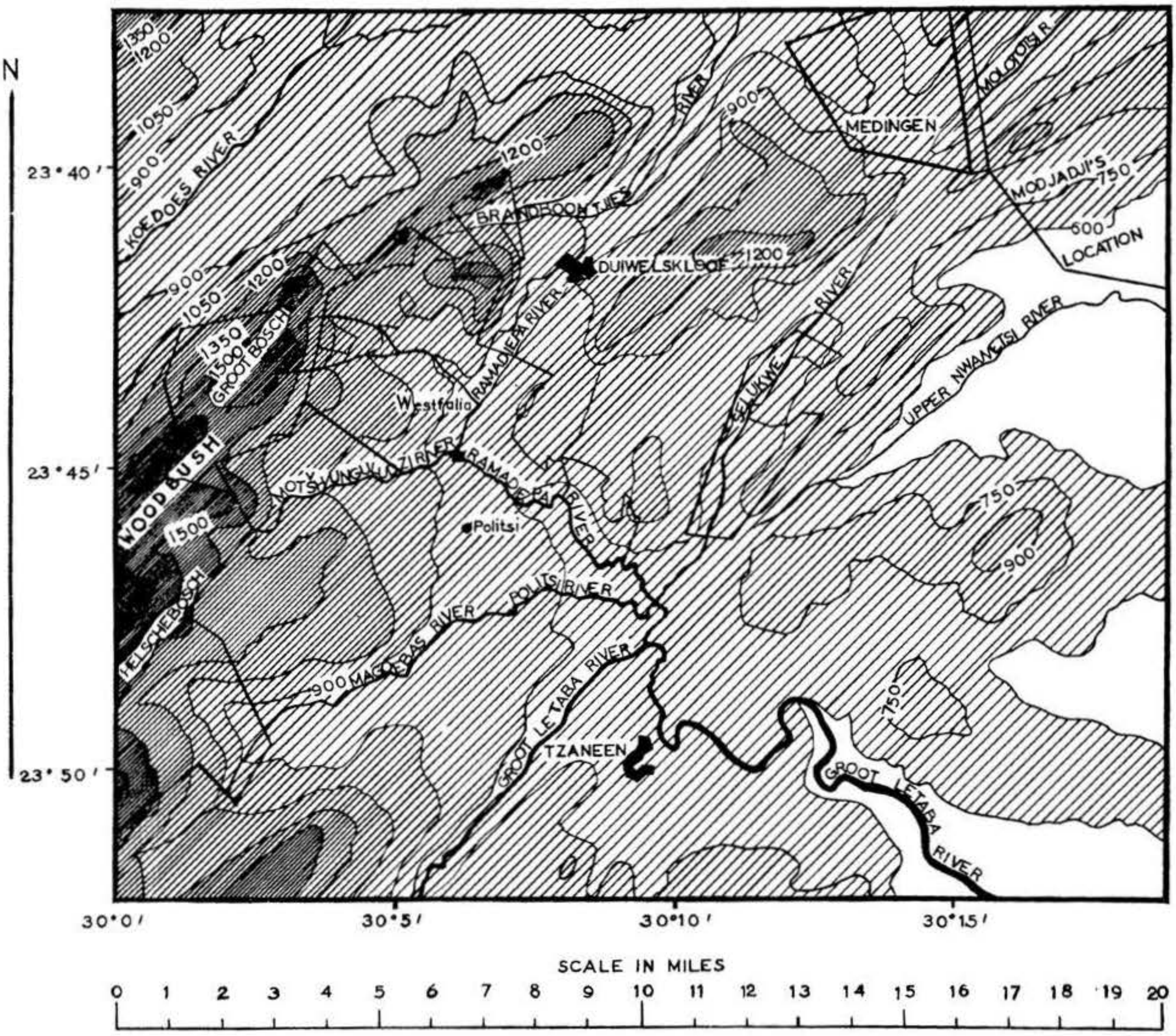


Fig. 2. Topographical map of the vicinity of Westfalia Estate. Note the prevailing southwesterly-northeasterly orientation of the spurs and foothills and the main streams. The altitudes of the contour lines are approximated in metres.

consequence of the very uniform prevailing direction of strike of the foliation planes of schistose rocks and of the banding of gneissic rocks (Mellor, 1907) and perhaps the lesser influence of the dykes.

The present-day topography of the region appears to be the result of a number of erosion cycles and bears their impress in the form of erosion surfaces (King, 1951; Obst & Kayser, 1949; Taljaard, 1938).

The area investigated lies in an embayment of the southern end of the plateau phase of the Great Escarpment (henceforth to be referred to as the Escarpment) at the northwestern end of the Groot Letaba River basin. The northwestern rim of the embayment is formed by the Rakgwale Ridge spur complex which extends far to the northeast and includes the mass of Piesang Kop as a large southerly extension. The summits of Piesang Kop and the Spitskoppie on the Rakgwale Ridge exceed 1400 m in height above sea level. A smaller spur extends down from the Escarpment roughly along the southern half of Rosendal and includes the Central Hill (about 1200 m high), sprawling between the Mtataspruit and the Motshunguludzi and Ramadiepa Rivers.

Westfalia Estate is bounded on the west by the edge of the Escarpment, reaching up to about 1400 m elevation at the highest points, and the steeply rolling, much-dissected foothill areas stretch down to about 900 m altitude eastwards. Although still of the rolling type, the country below about 850 m to 900 m is, on the whole, less steeply graded. The terrain between 900 m and 750 m altitude consists largely of elongated broad-based low ridges alternating with usually slightly inclined broad valley-bottoms frequently carrying sluggish streams. The gradients level out even more as the lower foothills grade into the Lowveld proper below about 750 m elevation.

The wide range in altitude, the great variations in gradient, the much-dissected terrain and the marked differences in aspect result in a great diversity of natural habitats. Nevertheless, it must be remembered that there is a predominance of northerly to westerly and southerly to easterly aspects owing to the prevailing trends of the spurs and river valleys.

As a rule, precipitation and the incidence of mist increase, whereas prevailing temperatures decrease, with increase in altitude. On this basis, the habitats of the area can be classified into two main climatic groups, viz. those of the Mistbelt and those of the Low Country below it. The boundary between these two belts is ill-defined and irregular because of the variation in the altitudinal distribution of the mist at different times and in different places. However, the lower altitudinal limit of the Mistbelt can be arbitrarily fixed at about 1050 m elevation.

The relationship between aspect and moisture is all the more evident owing to the fact that the Escarpment and its spurs are orientated more or less broadside on to the moisture-bearing winds. Not only do the south- to east-facing slopes receive heavier precipitation than the northerly to westerly slopes, but the spurs may also be responsible for broad rain-shadow effects to the northwest of their heights. A slight rain-shadow effect appears to exert some influence over the nek, the upper Brandboontjies River valley and the portion of the Rakgwale Ridge immediately to the northwest of the summit portion of Piesang Kop.

The northern to western slopes are more exposed to the direct insolation of the midday and afternoon sun. This is especially so in the dry season and results in very striking contrasts between the climatic conditions obtaining on different sites in the same altitudinal zones, particularly between those with northwesterly and southeasterly aspects.

The conspicuous differences between the plant communities and the nature and rapidity of succession on these alternes reflect not only the strongly contrasted climatic conditions on opposite slopes but also the resultant edaphic differences, especially the nature and depth of weathering of the substratum and steepness of slope.

In highly dissected country of this nature, it is only to be expected that areas of slight gradient will be found in places at the bases of some steep slopes. The moisture draining from the slopes, whether by surface or subsurface drainage or both, tends to be impeded and to accumulate in these depressions or "kommetjies", resulting in local marshy conditions. The formation of such "kommetjies" is typically due to spring-sapping. Several rivulets have their sources or headwaters in such seepage areas. Marshy stretches with characteristic hygrophilous vegetation are also found in areas of slight gradient along streams and in close proximity to stream confluences.

Through its great influence on local climatic and edaphic conditions, the topography exerts a very important albeit indirect influence on the soil and vegetation, which will be traced in the succeeding pages.

2. SOILS

A reconnaisance survey of the soils of Westfalia Estate was undertaken in 1961 by H.C. von Christen, formerly of the Soils Research Institute. The following account is largely based on his report.

2.1 SOIL TYPES

Although the soils are, on the whole, relatively uniform, the occurrence of a number of soil types could be established, as enumerated below:

(A) WELL-DRAINED FERRALLITIC SOILS

(1) Predominantly Sedentary Soils.

(1.1) Litholic Soils Derived from Basic Igneous Rocks.

(a) Moderately Laterised Soils.

(b) Strongly Laterised Soils.

(1.2) Litholic Soils Derived from Acid Igneous Rocks.

(1.3) Moderately Shallow Soils Derived from Acid Igneous Rocks.

(a) Moderately Laterised Soils.

(b) Strongly Laterised Soils.

(2) Drift Soils.

(2.1) Well-Structured Red Drift Soils.

(2.2) Moderately to Poorly Structured Red Drift Soils.

(a) Moderately Structured Soils.

(b) Structureless Soils.

(2.3) Poorly Structured Brown Drift Soils.

TABLE 1. Distribution of soil types on Westfalia Estate, with reference to altitude and origin*

<table>
<tr><td rowspan="4">Altitudinal Belts</td><td colspan="6">Well-drained Ferrallitic Soils</td><td>Hydromorphic Soils</td></tr>
<tr><td colspan="3">Predominantly Sedentary Soils</td><td colspan="3">Drift Soils</td><td>Colluvial and/or Alluvial</td></tr>
<tr><td>Litholic</td><td colspan="2">Shallow to Moderately Shallow</td><td colspan="3" rowspan="2">Moderately Deep to Deep</td><td rowspan="2">Moderately Deep to Deep</td></tr>
<tr><td>Basic Igneous Rock</td><td colspan="2">Acid Igneous Rock</td></tr>
<tr><td>Low Country (Below 1050 m)</td><td>(a) Moderately laterised</td><td rowspan="2">Litholic soils derived from acid igneous rocks are rare</td><td>(a) Moderately laterised</td><td>Well-structured red drift soils</td><td>Moderately structured red drift soils</td><td>Structureless red drift soils</td><td rowspan="2">The distribution of hydromorphic soils is not closely correlated with altitude but they are more common in the Low Country</td></tr>
<tr><td>Mistbelt (Above 1150 m)</td><td>(b) Strongly laterised</td><td>(b) Strongly laterised</td><td colspan="3">Poorly structured brown drift soils</td></tr>
</table>

TABLE 2. Frequency of occurrence of soil types on Westfalia Estate*

<table>
<tr><td>Altitudinal Belts</td><td>Predominant</td><td>Dominant</td><td>Frequent</td><td colspan="2">Rare</td><td>Very Rare</td></tr>
<tr><td>Low Country (Below 1050 m)</td><td>Moderately structured red drift soils</td><td>Structureless red drift soils</td><td>Well-structured red drift soils
Hydromorphic soils</td><td rowspan="2">Litholic moderately laterised soil derived from basic igneous rock and litholic soil derived from acid igneous rock</td><td rowspan="2">Swamp
Rocky land
Kloofs</td><td rowspan="2">Gullied land and moderately shallow moderately laterised soil derived from acid igneous rock</td></tr>
<tr><td>Mistbelt (Above 1150 m)</td><td></td><td>Poorly structured brown drift soils
Moderately shallow, strongly laterised soil derived from acid igneous rock</td><td>Litholic strongly laterised soil derived from basic igneous rock</td></tr>
</table>

*Adapted from original table. H.C. von Christen. Reconnaisance Survey of the Soils of Westfalia Estate, Northern Transvaal. Unpublished Report 1196/62, Soils Research Institute, Pretoria.

(B) HYDROMORPHIC SOILS

(1) Seasonally Wet Soils.

(2) Permanently Wet Soils.

(C) MISCELLANEOUS LAND TYPES

(1) Rocky Land.

(2) Gullied Land and Kloofs.

(3) Swamp.

In addition to the above more widespread soil and land types, it can be noted that a patch of coarse, gravelly, sandy alluvial soil occurs on a miniature floodplain near where the Motshunguludzi Stream enters the Merensky Dam. This is considered to be too limited in extent to merit inclusion in Tables 1 and 2.

Tables 1 and 2 show the distribution pattern of the above soil types in relation to altitude and origin, and their relative abundance. A good deal of overlapping occurs in the transition zones at the lower edge of the Mistbelt, viz. in the altitudinal range of about 1050 m to about 1200 m. This is only to be expected in view of the diversity of climatic conditions obtaining in each altitudinal zone. As can be seen, however, the soils of the Mistbelt above this transition zone and the soils of Low Country below it are fairly distinct.

(A) WELL-DRAINED FERRALLITIC SOILS

The great majority of soils on Westfalia Estate belong to the Great Soil Group of Red Ferrallitic Soils, i.e. the Lateritic Red Earths of Van der Merwe (1940), irrespective of their altitude, the nature of their parent material, or whether they are residual or derived from transported material.

The mature ferrallitic soils are strongly, sometimes excessively, weathered, often to a great depth, with the weatherable minerals in the mineral soil very low to virtually absent. These soils are typically clayey, friable and massive with poor horizon development but well drained both externally and internally, being porous owing to the high percentage of amorphous iron in the clay fraction. In view of the good internal drainage, there is a favourable moisture regime with a usually high level of available moisture under the rainfall conditions normally prevailing.

Although inherently infertile, the ferrallitic soils have an adequate supply of plant nutrients under a stable plant cover. Apart from the sesquioxides of iron and aluminium and some amorphous iron, the clay minerals consist largely of kaolinite. The clay minerals have a low cation exchange capacity while the base saturation and pH are also low. The cation exchange capacity, and hence the nutrient balance of the soil, is consequently very intimately related to and dependent on the amount and quality of organic matter present.

Within the limits of the above description, the fertility, acidity, humus content, structure and, to a lesser extent, texture - all factors affecting and affected by the vegetation - vary as the climate varies with altitude. The more elevated country not only enjoys higher rainfall (with much mist in the Mistbelt) but also lower temperatures than are experienced at lower levels. Consequently, the evapotranspiration at higher levels is potentially lower in relation to rainfall and more of the rainfall is available for leaching than at lower levels. The soils of the Mistbelt are understandably more leached and laterised and probably less well structured on the whole, usually with a higher humus content (which makes them more acid), lower cation exchange capacities and less exchangeable bases than those of lower altitudes. "There is a very significant difference in base saturation between the Mistbelt soils and the red drift soils of the low-lying country" (Von Christen, Unpubl.). Expressed percentage-wise, the base saturation of the former is below 10 per cent, while that of the latter varies from 30 per cent to 60 per cent.

"The indigenous forest soil differs from veld soils by its higher humus content in the top soil and subsoil apart from its accumulation of organic material in the forest floor. Differences in surface exposure between the two vegetational types are probably a contributing factor to the difference in soil humus" (Von Christen, Unpubl.).

"The amount of exchangeable bases is extremely low for humiferous forest soils and reflects the high degree of leaching of the mineral soil" (Von Christen, Unpubl.). Although the mineral soils are usually very leached and the rocks largely depleted of their weatherable minerals, the litter of the Mistbelt forests is relatively rich in plant nutrients which are taken up by the forest vegetation as soon as they become available after having been leached out of the decomposing litter (see Table 15, p. 234). The same type of nutrient cycle is also to be found on the more leached soils of the country below the Mistbelt, e.g. the structureless red drift soils (see Table 14, p. 89).

Plate 1. Soil profile exposed by bulldozing in preparation of the site of the Nokeng-e-Chweu Dam in Rosendal. Note the well-decomposed underground layer of saprolite below the darker soil layer.

Although the humus content is usually low in the Low Country soils, the organic matter still plays a very important rôle in maintaining soil fertility.

(1) Predominantly Sedentary Soils. Sedentary soils derived from basic igneous rocks are litholic, i.e. shallow, rocky and bouldery, and vary greatly in their degrees of laterisation according to altitude and the parent rocks concerned. Soils derived from such rocks as amphibolites and serpentinites at high altitudes are more strongly laterised than those derived from diabase (or dolerite) at low elevations. Strongly laterised soils derived from metamorphosed basic and ultrabasic igneous rock are quite common in the Mistbelt but they do occur at lower altitudes as well. No deep sedentary soils could be definitely identified as having been derived from these rocks. It would appear, however, that many of the better-structured drift soils are probably almost entirely derived from metamorphosed basic and ultrabasic igneous rocks or schists.

Sedentary soils derived from acid igneous rocks are not usually litholic. Very stony ground derived from these rocks can be grouped here although such ground has not always been formed *in situ*. Granitic-gneissose rocks have, in places, also given rise to predominantly sedentary soils which are generally less than 1 m deep (moderately shallow to shallow).

(2) Drift Soils. "Drift soils are much more common than sedentary soils. There is often no morphological evidence for the type of parent rock" (Von Christen, Unpubl.). The preponderance of acid igneous rock, however, leaves little doubt that these rocks are the common parent materials of by far the greater part of the overlying soils.

Many of the more mature soils are moderately deep to deep, i.e. exceeding 1 m in depth. Some borings in the area have penetrated variously weathered decomposed "Old Granite" (i.e. Archaean granite-gneiss) to depths of 100 ft (30 m) or more before striking fresh rock (Gevers, 1948) (see Plate 1).

"Owing to the enormous soil depth, fresh rocks of granite or gneiss were not exposed during the survey. Granitic boulders in and on top of the soil have lost most of their weatherable minerals; this applies even more to the decomposed rock (saprolite) which underlies the soil for many feet" (Von Christen, Unpubl.). As a rule, deep and moderately deep soils give some indication of transportation.

"The Drift Soils are classified according to their structure, humus content and colour, . . . The structure of the Drift Soils is influenced by various factors amongst which the quantity of the clay minerals is probably the most important one" (Von Christen, Unpubl.). The colour of the Mistbelt subsoils differs distinctly from that of the Low-Country subsoils. The red colour of the ferrallitic soils below the Mistbelt is essentially due to the presence of hematite. A yellowish to reddish brown "subsoil colour in the Mistbelt is the result of smaller amounts of hematite, together with a masking effect of the humus. The topsoil and subsoil colour after removal of the organic matter is red-yellow. Brown soils are more humiferous and leached than the red soils" (Von Christen, Unpubl.).

(B) HYDROMORPHIC SOILS

"Hydromorphic soils (Vlei soils) occur in the valleys and smaller depressions of the low-lying country. Along streams they generally consist of alluvial deposits with marked textural stratification while they are of colluvial origin in isolated troughs" (Von Christen, Unpubl.).

The Hydromorphic soils may be classified according to their moisture régimes into:

(1) <u>Seasonally Wet Soils</u> (dry in winter)

(2) <u>Permanently Wet Soils</u> (moist in winter).

There are indications that the moisture régimes of many of these soils has changed considerably in the past three decades. Soils which, it seems, were formerly permanently moist and poorly aerated are now dry in winter and the sites are available for uses other than the conservation of moisture. These soils have a high humus content and cation exchange capacity but they are acid, with a very low ratio of adsorbed bases in relation to the total value of adsorbed ions.

(C) MISCELLANEOUS LAND TYPES

Swamps, rocky land, gullied land and kloofs are relatively limited in extent and are mainly of importance in connection with soil and water conservation (see p. 284).

2.2 PLANT-SOIL RELATIONSHIPS

The concentration of nutrients in the humus layer is especially pronounced in the forest floor of the Mistbelt high forests. Most high forest species are well adapted to this condition, being very largely shallow-rooted, at any rate as far as surface or "feeding" roots are concerned, although several tree species develop "sinkers" or anchoring roots. In tropical rain forest, Richards (1952) has noted that: "The majority of roots, including nearly all the 'feeding roots', are in the upper layers of the soil." In an investigation of a 40-year old forest in Ghana by Greenland and Kowal (1960), 85.5 per cent by weight of roots were found in the top foot (approx. 30.5 cm) of soil. These authors stress the indispensable rôle played by the organic matter in the plant-nutrient cycle in tropical forest, where decomposition is so rapid and complete. In South Africa, Phillips (1931) has noted that the trees in the Knysna region are remarkably shallow-rooted for their size. This agrees with observations made by the author at road cuts and other excavations in forests. Von Christen (Unpubl.) has emphasised the importance of an adequate turnover of litter and humus for the maintenance of soil fertility (see also discussion, p. 269-73).

The more fertile soils usually have less moisture for long periods and vice versa. As outlined above, the distribution of soil types bears a relation to altitude and hence to climate, which in turn determines the nature and the course of development of the vegetation which, again, influences the nature and development of the soil. No instances of direct correlation between vegetation and soil conditions have been observed except in so far as both are influenced by macroclimatic, or ecoclimatic and other local conditions.

Regardless of their origin, the parent materials have weathered to a very uniform type of soil under subtropical conditions of high rainfall. Within the area, both the soils and the plant communities show gradual changes as the climate changes with increase in altitude. The area investigated thus provides a good illustration of the intimate developmental interrelationship of the climate-soil-vegetation complex, in which climate plays the decisive rôle.

To conclude, no general cause-and-effect relationship between soil and vegetation could be observed or inferred. Where the vegetation is closely correlated with edaphic conditions, the correlation is characteristically between specialised or stunted vegetation and limiting factors. Limiting factors may be extreme conditions of infertility, exposure and temperature and, more particularly, temporary or permanent shortage or excess of water. Such deficiency or excess of water in the substratum would be associated with extreme conditions of rockiness, drainage, aeration and acidity. All these factors are capable of influencing root development and, hence, indirectly as well as directly, the water relations of plants.

3. CLIMATE

Westfalia Estate lies between latitudes 23° 40' and 23° 46' south, in other words, approximately 13 to 19 minutes south of the Tropic of Capricorn. The climate, nevertheless, can hardly be regarded as tropical. In fact, owing to the variation in altitude, not all parts can be regarded as having even a subtropical climate in any strict sense.

The marked influence of relief on climate was mentioned in the course of the discussion of topography. Unfortunately, little information is available for Westfalia Estate but the differences between the Mistbelt and Low Country climates can be inferred from the records of nearby weather stations.

Unless otherwise stated, the statistics cited in this section are taken from the South African Weather Bureau's "Climate of South Africa" publications and are, for the most part, derived from records extending up to 1950. Subsequent data, gleaned directly from the rainfall and temperature records kept at the Weather Bureau in Pretoria, have been taken into account and cited where relevant. Use has also been made of the private records of rainfall registered at Eldorado homestead (Campsiesieglen-Werne) although these may not be altogether reliable.

3.1 INSOLATION

No information on the daily amounts of sunshine received locally appears to be on record. The duration and intensity of radiation vary not only with the immediate topography but also with the position in relation to the Escarpment, which cuts off the sunshine in the later afternoon, especially during the winter. No further details are available beyond the empirical observations of the sometimes profound differences in insolation experienced by the northern to western xeroclines and the southern to eastern mesoclinal slopes. On the whole, the area would appear to receive between 50 and 70 per cent of the amount of bright sunshine possible per year. At the most, 60 per cent to less than 50 per cent of possible bright sunshine is experienced during January, as contrasted with between 70 per cent and 80 per cent received in July (Weather Bureau, S.A., 1950). During both winter and summer, the Mistbelt tends to have less bright sunshine than the Low Country.

3.2 TEMPERATURE

It is an axiom of plant ecology that it is the extremes of a

TABLE 3. Annual march of temperature extremes and ranges in degrees centigrade at five stations in the Duiwelskloof-Tzaneen region of the Escarpment*

Station	Altitude	Period	January				February				March				April				May				June			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Woodbush	1528 m	1931-60	35.3	5.7	29.6	8.9	31.7	7.3	24.4	8.1	29.4	7.8	21.6	8.0	29.4	1.7	27.7	8.9	27.2	-0.9	28.1	10.0	25.5	-1.9	27.4	10.0
Pigeonhole	1265 m	1921-33	32.2	10.0	22.2	8.6	33.6	9.4	24.2	8.1	31.1	10.0	21.1	7.4	29.4	7.2	22.2	7.3	30.6	4.4	26.2	7.4	24.4	3.9	20.5	7.9
New Agatha	1097 m	1933-48	33.4	9.7	23.7	8.7	32.1	10.3	21.8	8.8	32.1	10.2	21.9	7.5	29.8	7.5	22.3	8.4	26.9	0.6	26.3	7.4	27.0	2.5	24.5	7.4
Belvedere	975 m	1936-60	36.2	6.4	29.8	12.0	36.5	10.8	24.2	11.8	38.3	8.0	28.5	11.7	33.4	4.4	29.0	12.6	32.1	0.4	31.7	13.6	30.7	-0.6	31.3	14.4
Pusella	749 m	1931-62	39.7	9.7	30.0	11.4	39.9	10.8	29.1	10.9	37.8	7.5	29.5	11.3	36.1	1.7	34.4	13.4	34.0	-0.8	33.8	16.7	32.5	-1.4	33.9	18.1

July				August				September				October				November				December				Year				Period
A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	E
24.4	-1.8	26.2	9.8	27.7	-1.9	29.3	10.6	32.6	-1.2	33.8	11.6	33.6	1.2	32.4	10.9	32.8	3.9	28.9	10.4	36.8	5.0	31.8	9.5	36.8	-1.9	33.8	9.7	38.7
26.7	2.2	24.5	7.9	29.4	2.8	26.6	8.8	36.4	3.1	33.3	10.3	33.9	3.3	30.6	10.3	34.4	6.7	27.7	9.8	35.0	10.0	25.0	8.8	36.4	2.2	33.3	8.6	34.2
26.7	1.4	25.3	8.3	29.1	1.7	27.4	10.0	32.2	3.6	28.6	10.2	35.3	4.7	30.6	10.9	35.9	6.7	29.2	9.1	35.3	8.9	26.4	8.5	35.9	0.6	30.6	8.7	35.3
29.4	-1.4	29.8	14.3	32.3	1.2	31.0	15.0	36.0	1.1	34.9	15.1	39.7	5.4	34.3	13.6	38.9	4.8	34.1	12.3	37.3	9.2	28.1	11.8	39.7	-1.4	34.9	13.2	40.3
32.5	-2.8	35.3	18.1	34.7	-1.9	36.6	18.0	38.8	1.1	37.7	17.0	41.9	4.4	37.5	15.0	41.2	5.5	35.1	13.4	41.1	5.8	35.3	12.2	41.9	-2.8	37.7	14.6	44.7

LEGEND:

A = Extreme daily maximum temperature during period

B = Extreme daily minimum temperature during period

C = Extreme range in temperature experienced during period (A-B)

D = Average daily range in temperature during period

E = Extreme difference in temperature within period ($A_{Year} - B_{Year}$)

* Compiled and adapted from Tables I and II (p. 65 & 110-111) in the S.A. Weather Bureau's "Climate of South Africa" Publication W.B.19 "Climate Statistics" (1954). Data revised in the light of subsequent records at the Weather Bureau, Pretoria.

climatic factor that are decisive in limiting the distribution of a species or a plant community. Table 3 provides a juxtaposition of absolute extremes and ranges of temperature recorded for each month and for the periods concerned, as well as the mean daily ranges per month of five different stations (see also Fig. 3, p. 27).

The following general inferences can be drawn from Table 3:

1. Maximum temperatures increase from the Escarpment heights (Woodbush) down to the Lowveld (Pusella).
2. Minimum temperatures are higher on the spurs, mountain slopes and foothills than on top of the Escarpment and below the foothills.

The juxtaposed minimum temperatures of the different stations for the winter months reflect the cold-air drainage patterns. On calm nights, cold air drains rapidly from the slopes and foothills into and down the river valleys and thence, more slowly, into the Lowveld. This explains the low temperatures experienced during calm winter nights in the more gently sloping river valleys of the Lowveld Sour Bushveld and adjoining areas (see Frost below). Temperature inversion results in the occasional occurrence of frost in depressions in the vicinity of the foothill stations of Pigeonhole and New Agatha, as observers have remarked (e.g. McCallum, MS.).

Table 3 and Fig. 3 (p. 27) also demonstrate the differences in the monthly means of the daily ranges of temperature at different stations at high and low altitudes, as well as the extreme ranges of temperature recorded per month. The greatest daily ranges are experienced in early spring, before the advent of the rainy season, whilst the smallest daily ranges occur in late summer and early autumn. The extreme and mean ranges in temperature as set out in columns C and D disclose that the foothill stations New Agatha and Pigeonhole enjoy a more equable type of climate than the Low Country stations Belvedere and Pusella, more equable even than that of Woodbush on the Escarpment. At the higher altitudes on top of the Escarpment, the high-level continental climate of the Pietersburg Plateau begins to exert an influence.

Frost. The slopes and foothills with good air drainage are frost-free. The stations Pigeonhole, New Agatha and Mamathola (altitude: 1052 m; records: 1904-1915) have no official records of subzero temperatures. Table 3 reveals that frost is more frequent in parts of the Lowveld Sour Bushveld and on the Escarpment than on the intervening foothills and mountain slopes.

Frost has been experienced at Belvedere in only three years out of

TABLE 4 - Occurrence of frost at three stations in the Duiwelskloof-Tzaneen region of the Escarpment *

Station	Altitude	Occurrence of frost								
		A	B	C	D	E	N	O	P	F
Woodbush	1528 m	14/7	24/7	10	1/6	16/9	29	16	55	0.8
Belvedere	975 m	30/6	30/6	-	3/6	29/7	14	3	21	-
Pusella	748 m	8/7	14/7	6	4/6	30/8	19	12	63	1.0

LEGEND:

- A Average first date of frost
- B Average last date of frost
- C Average duration of frost period in days
- D Extreme first date
- E Extreme last date
- N Number of years of data
- O Number of years in which frost occurred
- P Percentage of years in which frost occurred
- F Average number of frost days per year

* Adapted from Table III (p.117) in S.A. Weather Bureau's "Climate of South Africa" Publication W.B.19 "Climate Statistics" (1954).

14, as contrasted with Pusella, which has had 12 frost-years out of 19, and with Woodbush, with 16 out of 29 years.

Westfalia Estate is, in the main, probably less frosty than Belvedere and can be considered frost-free except for frost-pockets and valley-bottoms. The valley of the Ramadiepa River above the Merensky Dam and, to a lesser extent, the open parts of the Mtataspruit and the Selukwe River valleys are liable to frost at times. The more open parts of the stream-valleys on Boschhoek and Graskraal are occasionally subject to light ground frosts. In exceptional winters, such as the late July and early August of 1960, frosts have been more severe in the valley-bottoms. On that occasion, the stand of Echinochloa pyramidalis (introduced from the Lowveld), as well as soft herbs such as Impatiens duthieae, sustained extensive frost damage for some distance downstream of the confluence of the Mtataspruit and the Ramadiepa River.

It has been pointed out (p. 16) that the terrain between 750 m and 900 m altitude consists largely of alternating broad low ridges and valley-bottoms. This topographical zone corresponds to the "Lowveld Sour Bushveld Transition" vegetation zone (see Fig. 5 , p. 52) of the Savanna Woodland Vegetation Belt. Within this broad vegetation zone, two variants can be distinguished which can be called the "Ridge Variant" and the "River-Valley Variant". The Ridge Variant of the Lowveld Sour Bushveld Transition vegetation zone is characterised by the presence of the less frost-hardy Lowveld plants. These plants are absent from the river-valleys, apparently owing to the occurrence of frost in the latter situation although other factors, e.g. impeded drainage, may also play a part. Such frost-sensitive species are, e.g. Ehretia amoena, Ficus sycomorus and Pterolobium exosum.

At the most, only relatively few species appear to be excluded by frost from frosty localities or to suffer frost damage during unusually cold spells. As a rule, frosts are so mild and occur so seldom that frost plays a very minor rôle in the local distribution of indigenous plants.

3.3 WIND

Very little documentary information appears to be available on the relative strengths, prevalence and directions of the winds of the area, so that general empirical impressions will have to suffice.

Easterly to southeasterly trade winds from the Indian Ocean appear to be prevalent during the warmer months. These winds show less diurnal backing to northwest than is experienced farther south (Jackson, 1947). Persistent easterly to southeasterly winds usually

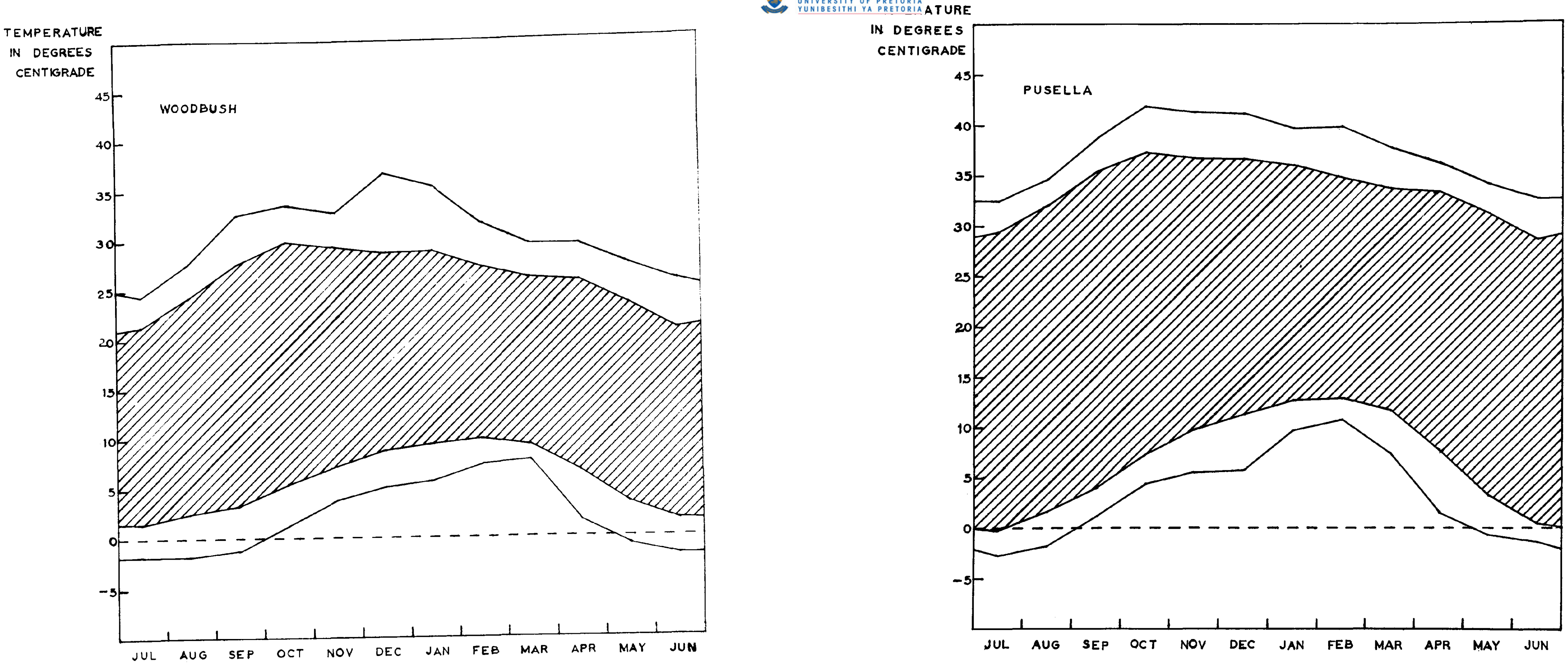


Fig. 3. Deasy graphs depicting the annual march of extreme daily maximum and minimum temperatures recorded per month at Woodbush (1921-60) and Pusella (1931-62) (cf. Table 3 in this account), with the hatched portions bounded by the curves of the mean monthly maximum and minimum temperatures calculated from records until 1950, as given in Table 1 (p.65) in S.A. Weather Bureau's "Climate of South Africa" Publication W.B.19 "Climate Statistics" (1954).

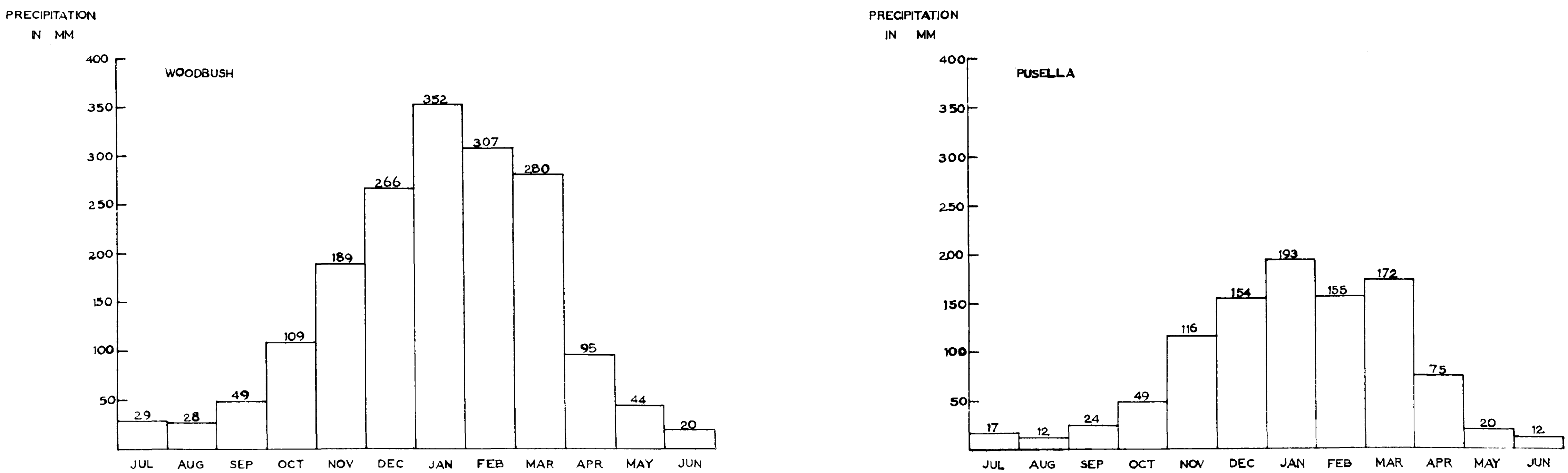


Fig. 4. Histograms representing the rainfall régimes of Woodbush (left) and Pusella (right), the mean monthly rainfalls averaged over 45 and 27 years respectively. Based on Table 1 (p.65) in S.A. Weather Bureau's "Climate of South Africa" Publication W.B.19 "Climate Statistics" (1954).

herald the approach of steady rains, drizzle or misty weather.

Southerly to southwesterly winds often blow during the cooler months of the year, bringing cold and, sometimes, misty and drizzly weather. These winds tend to become less frequent towards midsummer. They sometimes blow in early summer, especially in the afternoon, bringing with them the weather conditions of the plateau and Escarpment areas farther south, including isolated thunderstorms.

Although of short duration, "bergwind"-like winds, which drop over the Escarpment from the Pietersburg Plateau, sometimes wreak havoc amongst cultivated trees, especially in eucalypt plantations. However, the indigenous vegetation does not appear to suffer much wind damage.

3.4 PRECIPITATION

From the foregoing discussion of various environmental factors, it would seem that geology and soils, topography and insolation and the related climatic factors, temperature and wind, are of relatively little importance to the vegetation except in so far as they are related to, modify or are modified by the moisture relations existing between the plant and the environment. Indeed, moisture relations appear to be directly as well as indirectly the decisive factors in the environment. Moisture relations throughout the year are, to a large extent, determined by precipitation and atmospheric humidity. Unfortunately, the available data are insufficient to permit of any generalisation concerning atmospheric humidity.

As with temperature, the extreme values of precipitation, especially minima, experienced from time to time are more significant ecologically than the average annual values. More important yet is the nature of the precipitation and its distribution throughout the year.

The precipitation consists predominantly of rainfall supplemented locally to a varying extent by fog drip (see p. 32). Hail occurs only rarely during thunderstorms early in the rainy season. As far as can be ascertained, snow has never been seen below the actual Escarpment. In mid-September, 1930, the top of the Wolkberg and the plateaux of the Iron Crown and Woodbush Mountains were under heavy snow. Even the oldest natives had never before seen or heard of snow (McCallum, MS.).

TABLE 5. Mean annual and absolute maximum and minimum rainfalls in the Duiwelskloof-Tzaneen region of the Escarpment*

Climatic Belts	Station	Altitude	Period in years†	Annual Precipitation				Maximum in 24 hours		Highest Monthly Precipitation in period		Period of Operation
				Mean mm	Max. mm	Min. mm	Range mm	mm	Date	mm	Month	
Mistbelt	Broederstroom ..	1554 m	35(47)	2088.4	3656.3	1032.8	2623.5	415.3	22.3.48	1344.0	Jan., 1958	July, 1915 to date
	Woodbush 1	1528 m	45(55)	1767.7	3233.6	878.8	2354.8	362.5	22.3.48	1297.3	Jan., 1915	Nov., 1904-July,1960
	Pigeonhole	1265 m	35	1311.1	2128.0	617.5	1510.5	152.4	18.2.38	1292.4	Jan., 1915	Jan, 1911-Sept.,1948
	De Hoek	1219 m	26(38)	1672.6	3207.5	1045.2	2162.3	317.5	22.3.48	1148.9	Jan., 1958	May, 1923 to date
	New Agatha§.....	1097 m	14(26)	1391.4	2482.3	741.7	1740.6	396.0	8.11.60	1203.7	Jan., 1958	Sept., 1933 to date
Low Country	Belvedere	975 m	14(26)	1244.6	2050.4	789.4	1261.0	292.1	23.4.48	795.7	Jan., 1958	Sept., 1936 to date
	Westfalia	945 m	37(49)	1351.8	2030.2	543.9	1486.3	331.5	22.3.48	1028.2	Jan., 1915	May, 1914 to date
	Eldorado*	878 m	15	1208.5	1870.7	739.4	1131.3	309.4	4.1.48	847.9	Jan., 1958	Jan., 1947 to date
	Duiwelskloof ...	792 m	45(57)	1032.0	1602.2	391.4	1210.8	336.5	5.1.58	898.5	Jan., 1958	Jan., 1906 to date
	Zomerkomst	792 m	27(39)	1054.9	1736.5	526.8	1209.7	262.0	4.1.58	798.0	Jan., 1958	March, 1923 to date
	Pusella	749 m	27(39)	998.5	1591.9	454.7	1137.2	228.0	8.11.60	836.6	Jan., 1958	Feb.,1923-Sept.,1962

* Compiled from the records at the Weather Bureau, Pretoria, except for the records of Eldorado, which are kept at Westfalia Estate.

† The first figure refers to the number of years over which the mean annual rainfalls were calculated (i.e. up to and including 1950) as given in Table II (p.161) in S.A. Weather Bureau's "Climate of South Africa" Publication W.B. 20 "Rainfall Statistics" (1954). The second figure (in parentheses) refers to the number of years of which the records were used for determining the maxima and minima (i.e. up to and including 1962 or the date when the station closed down).

§ Independent observations suggest that the altitude of the rain-gauge at New Agatha Forest Station actually lies between 1140 m and 1175 m.

(A) RAINFALL

Apparently owing to the so-called "approach effect" (Daubenmire, 1959), the influence of the Escarpment on precipitation extends for some distance eastwards onto the Lowveld plains where the increased rainfall is probably mainly responsible for the development of the Lowveld Sour Bushveld as distinct from the drier Lowveld, Arid Lowveld and Mopani Veld veld types (Acocks, 1953). Table 5 illustrates the general increase in rainfall with increased altitude from Pusella in the Lowveld Sour Bushveld to Woodbush on the brink of the Escarpment and Broederstroom on top of the Escarpment.

As regards the nature of the precipitation over this area, probably a great deal of the so-called orographic precipitation is really instability or convective precipitation (Jackson, 1947). At the highest levels of the Escarpment, for instance at Woodbush, rainfall is at least partly orographic, taking the form of drizzle (Jackson, 1951). Cyclonic precipitation is exceptional (see p. 30). Thunderstorms in the Westfalia area are most frequent early in the rainy season becoming less so later, in contrast to the situation in the Cathedral Peak area (Killick, 1963).

The rainfall is strongly seasonal, as indicated by Fig. 4 and the data in Tables 6 to 9. By far the greater part of the annual precipitation occurs during the warmer months of the year from November to April.

The rainfall normals for Woodbush and Duiwelskloof, calculated over an identical 30-year period (Table 6) are fully comparable. On the whole, there is a greater disproportion in the seasonal distribution of rainfall than that shown in Table 6. Over the same 30-year period, 87.2 per cent of the annual rainfall at Duiwelskloof was experienced during the 6-month periods from November to April whereas the proportion for the same periods at Woodbush was 83.7 per cent.

Table 7 reveals that the rainfall received in the 6-month period from November to April varies, on the average, between 84 per cent and 90 per cent (Westfalia) of the annual total, but the seasonal distribution is fairly uniform over the whole region. The wettest quarter may be December to February, e.g. New Agatha, Belvedere and Eldorado, or January to March, e.g. Woodbush, Westfalia, Duiwelskloof and Pusella. During the driest quarter of the year, viz. June, July and August, less than 4.5 per cent of the mean annual rainfall is recorded. Winter precipitation percentages show a slight tendency to decrease towards the Lowveld. The very pronounced dry season and relatively warm winter are characteristic of the Northeastern-Transvaal Escarpment area.

TABLE 6. Rainfall normals of Woodbush and Duiwelskloof, 1921-1950 (30 years)*

Station	Altitude	Months												Year	Quarters								Rainy Season		Dry Season	
		Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Dec.-Feb.		Mar.-May		Jun.-Aug.		Sep.-Nov.		Oct.-Mar.		Apr.-Sep.	
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	%	mm	%	mm	%	mm	%	mm	%	mm	%
Woodbush	1528 m	307.3	297.4	294.9	102.6	40.4	23.1	32.3	30.7	51.1	106.7	188.5	266.7	1741.7	871.4	50	437.9	25	86.1	5	346.3	20	1461.5	84	280.2	16
Duiwelskloof	792 m	199.6	169.7	184.9	64.0	23.1	14.0	15.2	13.2	19.6	43.7	113.0	149.6	1009.6	518.9	51	272.0	27	42.4	4	176.3	17	860.5	85	149.1	15

*Adapted from Table I in S.A. Weather Bureau's "Climate of South Africa" Publication "Rainfall Statistics" (W.B.20): p.16 (1954)

TABLE 7. Percentages of mean annual rainfall received during different times of the year (averaged over varying periods)†

Climatic Belts	Station	Altitude	Period in years	Percentage of mean annual rainfall received during:					
				Nov.-April (6 months)	Nov.-March (5 months)	Dec.-March (4 months)	Dec.-Feb. (3 months)	Jan.-March (3 months)	June-Aug. (3 months)
				%	%	%	%	%	%
Mistbelt	Woodbush....	1528 m	45	84	79	68	52	53	4.4
	Pigeonhole..	1265 m	35	85	79	69	53	53	4.4
	New Agatha..	1097 m	25	84	77	65	54	48	4.5
Low Country	Belvedere...	975 m	25	86	79	69	55	53	4.3
	Westfalia...	945 m	48	90	83	71	55	56	3.9
	Eldorado†...	878 m	15	87	79	69	63	61	3.7
	Duiwelskloof	792 m	30	87	81	70	51	55	4.2
	Pusella.....	749 m	27	87	79	67	50	52	4.1

†Calculated from original data from the records at the Weather Bureau, Pretoria, except for the figures for Eldorado, the records of which are kept at Westfalia Estate.

This feature is more striking here than on the Drakensberg Escarpment farther south, but perhaps less so than on the Soutpansberg to the north.

As is evident from Figs. 3 and 4 and Table 3 (p. 25), the highest temperatures usually occur in the spring and early summer, before the three wettest months of the year. In other words, the regional climate is of the monsoon type in which three seasons can be recognised:

1. the rainy season (summer and early autumn)
2. the cool dry season (late autumn to early spring) and
3. the warm dry season (spring and early summer).

The usually erratic and far from effective rains of late spring and early summer are ordinarily insufficient to outweigh the harmful effects of high temperatures and low atmospheric humidities. Towards the end of the dry seasons the soil is frequently dried out to great depths. This is likely to render the uncertain rainfall of late spring and early summer even less effective for plant growth because of the very rapid internal drainage as well as the high rates of evaporation and run-off. These months are often very trying to plants, especially in the Low Country where prolonged dry-season conditions would often prove lethal to ill-adapted plants of the Mistbelt. As can be seen from Table 8, only three months of the year can be considered potentially rainless at Woodbush, compared with as many as six months at Pusella.

The spring rainfall is particularly erratic at lower elevations. In 14 out of 50 years of observations (1913-62), the October rainfall at Westfalia (945 m) has been less than 25 mm as compared with 23 years at Duiwelskloof (792 m). Von Christen (Unpubl.) found that over the 40-year period 1922-61, the combined rainfall for October and November at these stations fell below 100 mm on six and seven occasions respectively. During the same period, the rainfall from October to December (inclusive) has been 50 per cent and more below average during the seasons 1935-36 and 1946-47 at both stations and, in addition, during the 1926-27, 1932-33 and 1956-57 seasons at Westfalia (Von Christen, Unpubl.). It is surprising but unaccountable that the average number of rainy days per year at Westfalia is less than that at Duiwelskloof which in turn is less than that at Pusella (Table 9). For the rest, with the exception of New Agatha, the average number of rainy days per year appears to increase with the altitude of the station.

By comparing the records of various forestry centres over 20 hyetal years, Wicht (1949) has shown that the mean length of periods with

TABLE 8. Maximum and minimum precipitation recorded per month at Woodbush an

Station	Altitude	Period	Maximum and minimum precipitation recorded in mm																							
			Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.	
			Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Woodbush	1528 m	1905-60	1297.3	77.7	870.7	40.9	892.3	58.9	334.3	18.0	237.2	0.3	115.2	0.0	159.5	0.0	133.6	0.0	171.3	2.5	310.9	5.1	449.8	46.0	714.0	56.9
Pusella	749 m	1923-62	836.6	20.7	598.4	4.0	645.2	37.6	242.1	4.1	113.7	0.0	66.0	0.0	88.1	0.0	63.0	0.0	81.8	0.0	173.7	0.0	362.0	0.7	396.2	1.2

TABLE 9. Average number of rainy days per year and approximate mean rainfalls per rainy day at six rainfall stations in the Tzaneen-Duiwelskloof region*

Climatic Belt	Station	Period spanned (with number of years used in calculations)	Altitude	Mean annual rainfall during period in mm	Average number of rainy days per year during period in days	Approximate mean rainfall per rainy day in mm per rainy day
Mistbelt	Woodbush......	1904-60 (54 years)	1528 m	1827.1	138	13.2
	Pigeonhole....	1911-48 (31-35 years:- monthly basis)	1265 m	1311.5	110	11.9
	New Agatha....	1933-60 (24 years)	1097 m	1502.4	99	15.2
Low Country	Belvedere.....	1936-60 (24 years)	975 m	1308.1	106	12.3
	Westfalia.....	1914-60 (47 years)	945 m	1342.1	76	17.7
	Duiwelskloof..	1906-60 (53-55 years:- monthly basis)	792 m	1049.9	78	13.5
	Pusella	1923-60 (37 years)	749 m	1034.2	101	10.2

*Compiled from the records of the Weather Bureau, Pretoria.

all days each having less than 12.7 mm rainfall is 11.6 days for Woodbush (see Table 10). With the exception of Evelyn Valley in the Amatola Mountains, it is apparent that this period is shorter than that for other centres, including that for Cathedral Peak calculated over 20 calendar years (Nänni, 1956). Woodbush is in an exceptionally favourable position in its own region, however, and the less favourably situated places in the Tzaneen-Duiwelskloof region are subject to more lengthy dry periods.

Table 11 shows the relative frequency of drought-periods of differing degrees of severity, i.e. duration, for several stations in the area. For the purposes of this table, "droughts" were taken to be continuous periods during which no rain was recorded. The frequency values were calculated by dividing the number of droughts of each severity class recorded at each station by the number of years of which the records were used. Despite the limited comparability of the original data, the derived figures do bring out the increased liability to and severity of drought associated with the descent from the top of the Escarpment to the Lowveld. Not only are dry periods usually shorter in the Mistbelt but their effects are moderated by the relatively lower maximum temperatures and periods of higher humidity or mist (see p. 31).

As Trewartha (1954) points out, large variations in rainfall are characteristic of these climatic types, i.e. "Tropical Wet and Dry Climate" (cf. Table 8). The wide range in rainfall and the periodic low minima must be taken into account in reading the mean annual precipitation figures of the various stations if one is to arrive at a proper evaluation of their significance for the vegetation (see Table 5). The influence of periodic drought-years on the mean annual rainfall figures is counterbalanced and concealed by the exceptionally high rainfalls recorded in isolated years, e.g. in 1955, when most of the annual maxima in Table 5 were registered. In early January, 1958, the Northern Transvaal was struck by a tropical cyclone, the edge of which passed over the Duiwelskloof-Tzaneen region. This is reflected in the high maximum daily and, even more clearly, in the maximum monthly rainfalls recorded in the area at that time (Table 5). Such cyclonic conditions appear to occur only rarely, however.

Gevers (1948) found that in two hyetal years, reckoned from 1st September to 31st August, the rainfall at Westfalia (945 m altitude) exceeded 2540.0 mm (100 in.), reaching 2594.6 mm (1917-18) and 2808.2 mm (1924-25). There have also been such hyetal years with very low rainfalls, for instance 1913-1914 with 676.4 mm, as against the mean rainfall of approximately 1347.0 mm over 49 such years (1913-14 to 1961-62).

TABLE 10. Frequency distributions of dry periods over 20 years at various forestry centres in the summer-rainfall area (Daily rains of less than 12.7 mm disregarded)*

Station	Period	Number of days with less than 12.7 mm rainfall				
		1-15	16-60	More than 60	Total	Mean
Entabeni...........	1925-1945 (Hyetal years)	389	97	19	6440	12.8
Woodbush...........	"	445	79	15	6247	11.6
Weza	"	278	88	25	6549	16.7
Evelyn Valley......	"	474	94	4	5762	10.1
Cathedral Peak†....	1934-1953 (Calendar years)	371	91	19	6581	13.7

*Adapted from Wicht, C.W. 1949. Forestry and Water Supplies in South Africa. Bull.Dept.For. S.Afr. No.33, Govt.Pr.: Table No. 1 (p.15), except for Cathedral Peak Figures.

† Adapted from Nänni, U.W. 1956. Forest Hydrological Research at the Cathedral Peak Research Station. J.S. Afr. For. Assoc. No. 27: Table III (p.23). Calendar years.

The differences between the rainfall régimes of Pusella (749 m) and Woodbush (1528 m) are graphically presented in Fig. 4 (p.27). Westfalia Estate is situated between about 750 m and 1450 m elevation. One would expect the mean annual rainfall within this altitudinal range to vary between 1000 mm and 1750 mm. The area can conveniently be divided into two main climatic belts, viz. the Mistbelt and the Low Country. Assuming a roughly rectilinear relationship between the increase in altitude of from 750 m to 1450 m and the parallel increase in mean annual rainfall of from 1000 mm to 1750 m, the mean annual rainfall will increase, on the average, by roughly 75 mm for every 70 m increase in altitude. On this basis, the hypothetical boundary between the Mistbelt and the Low Country can be regarded as falling largely within an isohyetal zone receiving a mean rainfall of from 1250 mm to 1400 mm per year, if one accepts the lower altitudinal limit of the Mistbelt as lying largely between the 1000 m and 1100 levels. Places with mean rainfalls of less than 1250 mm per year would then probably fall into the Low Country climatic belt, while places with mean annual rainfalls of over 1400 mm would probably fall within the Mistbelt. Sites constituting the transition zone would, potentially, support vegetation types intermediate between Mistbelt types of vegetation and those of the Low Country. The precise nature of these communities will depend upon local circumstances.

Although one can arbitrarily set an average minimum elevation of 1050 m for the Mistbelt and subdivide both Mistbelt and Low Country into various climatic and vegetation zones, these belts and zones cannot really be strictly delimited on an altitudinal basis, owing to the profound influence of aspect and other topographic factors. The influence of topography on climate and vegetation tends to obscure the boundaries of the zones which dip down on the southern to eastern aspects and are raised on the northern to western slopes. The precipitation is not only greater on the southern to eastern aspects but is also more effective than on the opposite slopes. Nevertheless, for the sake of convenience in dealing with the vegetation, certain arbitrary altitudinal limits have been fixed for the various climatic and vegetation zones (cf Table 12, p. 34 and Fig. 5, p. 52). It must be stressed that these hypothetical zones grade imperceptibly into one another.

(B) MIST

The important influence of mist in tempering drought conditions has already been mentioned. Mist is generally experienced at levels

TABLE 11. Relative frequencies of droughts of various intensities*

Station	Altitude	Duration of records (in calendar years)	Period of records	Mean frequency of dry spells (in different severity classes) per year								
				Severity classes: Duration of rainless periods in days								
				14-20	21-40	41-60	61-80	81-100	101-120	121-140	141-160	161-180
Woodbush	1528 m	55	1905-1959	1.51	1.64	0.22	0.06	0.02				
Pigeonhole	1265 m	35	1912-1947 (except 1946)	1.74	1.54	0.43	0.09	0.03	0.03			
New Agatha	1097 m†	28	1934-1961	1.75	2.00	0.50	0.18	0.11				
Belvedere	975 m	23	1937-1959	1.74	1.83	0.09	0.09	0.09				
Westfalia	945 m	48	1914-1961	2.06	2.00	0.40	0.31	0.15	0.08	0.0	0.0	0.02
Duiwelskloof	792 m	51	1909-1961 (except 1913 and 1944)	2.06	1.94	0.57	0.37	0.06	0.0	0.02	0.0	0.02
Pusella	749 m	37	1924-1960	2.00	2.08	0.30	0.08	0.05	0.03			

*Compiled from the records kept at the Weather Bureau, Pretoria

†Independent observations by the author suggest that rain-guage at New Agatha Forest Station actually lies between 1140 m and 1175 m in altitude

well above 1050 m but is found lower down during very wet spells and on windward (especially southerly to easterly) slopes. Valley fogs are known to form below 1050 m altitude on still early mornings, but they are rare and usually soon dissipated by the heat of the sun.

When mist is carried through the crowns of trees, innumerable water droplets may settle on the foliage and branches and on epiphytic plants, often in sufficient quantity to coalesce into drops and drip onto the ground. This "fog drip" may increase the supply of moisture for these plants and for those under them to a significant degree during dry periods, particularly along exposed southern to eastern forest margins on mesoclines in the Mistbelt. Kittredge (1948) noted that, in favourable situations, "fog drip may at certain seasons increase the precipitation reaching the ground by amounts up to two or three times the precipitation in the open". Low-growing vegetation is not able to precipitate as much moisture from mist as trees can (Daubenmire, 1959; Kittredge, 1948; Means, 1927; Oberlander, 1956; Phillips, 1926, 1928 & 1931; Went, 1955).

In forests, fog drip helps to compensate for:

1. The greater amounts of rainfall intercepted by foliage and branches
2. The greater demands made on soil moisture by forest vegetation.

Even where conditions are unfavourable for fog drip, the effects of mist in reducing evapotranspiration are of great importance in the distribution of plant communities and species.

Several species of plants are more or less confined to the Mistbelt and extend below it only along the river valleys, e.g. epiphytic lichens such as certain species of _Ramalina_ and _Usnea_, numerous Jungermanniales, the Neckeraceous mosses _Neckera valentiniana_, _Pilotrichella chrysoneura_ and _P. panduraefolia_, the epiphytic ferns _Elaphoglossum acrostichoides_, _Pleopeltis excavata_ and _Trichomanes pyxidiferum_ var. _melanotrichum_, the epiphytic orchids _Mystacidium caffrum_ and _Tridactyle tricuspis_ and the trees _Cryptocarya liebertiana_, _Podocarpus_ spp. and _Syzygium gerrardii_ to mention but a few.

Fog drip is more significant when mists are moving. Very little moisture can be precipitated from stagnant mists. The valley fogs of still mornings, therefore, do little to improve moisture relations of plants and may actually prevent precipitation of atmospheric moisture in the form of dew, by preventing further cooling by radiation.

(C) DEW

Heavy dew formation, especially in the river valleys, is a feature of most parts of the Estate, particularly after rainy spells. The evaporation of the dew raises the humidity and checks rapid temperature rise, thus serving to conserve moisture by lessening the rate and duration of evapotranspiration. The characteristic heavy dew formation thus also serves to ease if not positively to counteract drought conditions.

It has frequently been observed that adventitious roots of certain plants, especially certain grasses, species of Commelina and Aneilema, Acanthaceae, Bridelia, Ficus, Cyphostemma, Mikaniopsis, Mikania and Rhoicissus for example, are covered with dew which can presumably be taken up directly by the plants. The question of the extent to which the vegetation can make direct use of superficial water is very pertinent, because the parts above ground are frequently sodden with dew and remain wet for a considerable length of time. This applies particularly to shrubby plants of ericoid habit such as Anthospermum ammanioides, Erica woodii, Hypericum revolutum and Myrsine africana.

3.5 CLIMATOLOGICAL CLASSIFICATION

For the purpose of referring to the differing climates of different elevations an attempt was made to differentiate and classify the climates of the area according to various systems.

According to Köppen's system (Schulze, 1947), the Mistbelt stations, Woodbush, Pigeonhole and New Agatha, each possess a Cwb climate or temperate (warm) climate with summer rainfall, i.e. a temperate type of monsoon climate, with the mean temperature of the warmest month below 71.6 F (approx. 22.1C). The climates of the Low Country stations Pusella and Belvedere are both classified as Cwa signifying a warm (or warmer temperate) climate with summer rainfall, i.e. a warmer type of monsoon climate, with the mean temperature of the warmest month above 71.6 F.

In accordance with Thornthwaite's 1931 classification, the climate of the upper levels of the Escarpment is given (Schulze, 1947) as BB'w, signifying a humid warm climate with a dry winter with forest as the "characteristic vegetation". The climate at lower levels of the Escarpment is designated as CB'r which denotes a "subhumid warm climate with . . . sufficient moisture in all seasons", with grassland as the "characteristic vegetation".

Thornthwaite's later (1948) system, based on the concept of "potential evapotranspiration", may well allow of a more sensitive subdivision of the Mistbelt and Low Country climates (cf. Schulze, 1958) but his methods proved to be difficult to apply.

In the opinion of Papadakis (1961), the shortcomings of Thornthwaite's methods were met by his own method of computing evapotranspiration. The

TABLE 12. Altitudinal distribution of vegetational and climatic zones with representative stations in the Duiwelskloof-Tzaneen region of the Escarpment

Climatic Belts	Station	Altitude*	Vegetation Zone	Climatic (Climax) Vegetation according to Papadakis†	Mean annual Rainfall in mm *	Climate† Papadakis Code	Climate† Papadakis Terminology
Mistbelt	Woodbush	1528 m	Upper High Forest Zone	Montane forest; monsoon forest, much of which is grassland and tropical rainforest, and semi-deciduous forest (according to the length of the dry season)	1767.7	Ci,M-TF,Hu and tp,M-tt,Hu	Humid Medium Tierra Fria and Humid Cool Tierra Templada
		±1500 m					
			Middle High Forest Zone				
		±1350 m					
	Pigeonhole ...	1265 m	Lower High Forest Zone		1311.1		
		±1200 m					
	New Agatha ...	1097 m§	High Scrub Forest Zone		1391.4		
		±1050 m					
Low Country	Belvedere	975 m	Low Scrub Forest Zone	Montane forest - mixed forest - monsoon forest (and savanna) - thorny woodland (according to the length of the dry season)	1244.6	Ct,c-TF,MO 4 or less dry months	Moist Monsoon Subtropical Tierra Fria
	Westfalia	945 m			1351.8		
		±900 m					
	Eldorado*......	878 m*	Lowveld Sour Bushveld Transition Zone		1208.5*	Ct,c-TF,MO 5 or more dry months	Moist/Dry Subtropical Tierra Fria
	Duiwelskloof ..	792 m			1032.0		
		±750 m					
	Pusella	749 m	Lowveld Sour Bushveld		998.5	Ct,c-TF,Mo	Dry Monsoon Subtropical Tierra Fria

*Compiled from Table II (p.161) in S.A. Weather Bureau's "Climate of South Africa" Publication W.B.20 "Rainfall Statistics" (1954) with the exception of Eldorado, the mean annual rainfall of which is calculated from the records kept at Westfalia Estate.

†Compiled from: Papadakis, J. 1961.

§Independant observations by the author suggest that the rain-gauge at New Agatha Forest Station actually lies between 1140 m and 1175 m in altitude.

climates of five representative stations classified according to the Papadakis system are set out below, and in Table 12.

The climate of Woodbush appears to fall into the class designated as Ci,M-TF,Hu or "Humid Medium Tierra Fria" in the terminology of Papadakis, i.e. humid, medium-altitude "non-frostless tropical highland", permitting the growth of citrus in winter and suited to maize cultivation in summer.

The climate of Pigeonhole is apparently to be classified as tp, M-tt,Hu or "Humid Cool Tierra Templada", i.e. humid cool "frostless highland", signifying that, although the winter is frost-free and the summer is suitable for growing maize, the climate is not warm enough for growing cotton.

New Agatha's climate would appear to be "Humid Medium Tierra Fria", like that of Woodbush. Although there is no documentary evidence of frost at the New Agatha station, an extreme daily minimum of 0.6°C suggests that ground frost is not unknown while observers (e.g. McCallum, MS.) have reported frost in stream valleys and other low-lying places nearby.

Papadakis' method does not differentiate between the Mistbelt climates of the foothills and the edge of the Escarpment except on the basis of presence or absence of frost. The differentiation between the foothill stations New Agatha and Pigeonhole and the grouping of New Agatha with Woodbush on this basis seems unrealistic for the purpose of correlating climatic zones with vegetation zones. It has been noted that New Agatha appears to be slightly more liable to drought than Pigeonhole which in turn appears more liable to drought than Woodbush (see Table 11, p. 32). In this instance, the relative liability to drought or the length of the dry season would seem to be more suitable means of differentiating the climatic variants of the Mistbelt, as in the case of the Low Country climates discussed below.

The climate of Belvedere would be classified as Ct,c-TF,MO or "Moist Monsoon Subtropical Tierra Fria". This signifies that, although not entirely frost-free, the winter permits the growth of citrus and tropical crops, whilst the summer is suitable for the cultivation of coffee, and those strains of cotton adapted to cool nights.

The climate of Pusella apparently belongs in the class Ct,c-TF,MO or "Dry Monsoon Subtropical Tierra Fria", similar to Belvedere's climate but drier and with a longer dry season.

Pusella appears to lie close to the boundary between the Dry Monsoon Subtropical Tierra Fria and the "Moist/Dry Subtropical Tierra Fria". Pusella also appears to lie in the Lowveld Sour Bushveld Vegetation Zone close to the Lowveld Sour Bushveld Transition Vegetation Zone. It seems plausible, therefore, to ascribe to the Lowveld Sour Bushveld Transition vegetation zone a "Moist/Dry Subtropical Tierra Fria" climate.

On the whole, it is evident that there is a fairly good correspondence between the Low Country climatic zones as delimited by means of Papadakis' methods and the vegetation zones recognised in this account as appears to be borne out by Table 12, but the climatic subdivision of the Mistbelt is less satisfactory from this point of view.

B. BIOTIC FACTORS

1. PLANTS

The influence of various plant species upon the plant communities can be considered under various heads depending on the nature of the influence, whether the plants are native or introduced and, if introduced, the nature of the agency responsible.

1.1 INDIGENOUS PLANTS

(A) DEPENDENT PLANTS

Vascular plants which are mechanically or physiologically dependent on other plants are integral constituents of plant communities. They are seldom numerous and their influence is, as a rule, practically negligible. Where sufficiently pertinent, they will be dealt with during the discussion of the relevant plant communities.

(B) INDEPENDENT PLANTS

(1) Native Plants. The artificial planting of locally indigenous species will be discussed under subsection 3. MAN (below).

(2) Introduced Plants. Plants introduced by man into this area from elsewhere in South Africa will also be dealt with under subsection 3. MAN (below).

1.2 EXOTIC PLANTS

Plants introduced from outside South Africa will be discussed under subsection 3. MAN (below) for, as far as can be ascertained, man has been the agency responsible for their introduction. A problematical exception is *Cyperus papyrus* subsp. *nyassicus*, which may have been introduced into the Merensky Dam by waterfowl. It is not clear whether *C. papyrus* is to be regarded as indigenous or as extending its domain naturally or as being assisted in its dispersal by cultivation for ornament. Hydrophytes are notoriously widely distributed and suitable habitats are widely scattered. Although there are other records of the species from South-West Africa, Tongaland, Zululand and Natal, this is apparently the first gathering of the species in the Transvaal and the first record of this subspecies in South Africa

(Podlech, 1961). The introduction of Cyperus papyrus into the Merensky Dam has had a far-reaching if localised influence on the hydrosere (see p. 57).

2. ANIMALS

2.1 INVERTEBRATES

The area under consideration is rich in invertebrates. Although the invertebrate fauna collectively exerts a strong influence on the soil and vegetation, individual species are seldom of any great direct importance for the vegetation.

It should be remembered that the presence of the pathogenic protozoans causing malaria and nagana (viz. species of Plasmodium and Trypanosoma respectively) and their insect vectors, anopheline mosquitoes and tsetse flies (species of Anopheles and Glossina respectively), was one of the most important reasons for the slow initial rate at which the area was settled by human beings.

The indispensable rôle of insects, especially of bees, wasps, butterflies, moths and flies, as pollinating agents is well known.

Of great indirect importance are the manifold effects of insects and other small animals, as well as the multifarious microfauna and microflora, on soil properties, especially on the physical structure of the soil and on the plant-nutrient cycle. Large accumulations of soil pellets have been observed on occasion in the vicinity of large nests of various ants, e.g. Streblognathus aethiopicus Sm., which evidently have pronounced local effects on the crumb-structure of the topsoil. Both large and small termitaria (probably of species of Macrotermes as well as other genera) were to be found in the Low Country, especially at lower elevations, and may conceivably have altered the course of succession over localised areas. The large-scale establishment of orchards and timber plantations has greatly reduced the populations of termitarium-building species of termites. Only a few scattered relict termitaria remain, often deserted or inhabited by colonies greatly reduced in strength. Some of the old crop-lands in the Low Country became heavily infested with termites after they had been abandoned - to the extent of hundreds of nests per morgen (Read, 1941) - and the termitaria had to be levelled before eucalypt plantations could be established (ibid.; A.E.G. Petersen, p.c.)

On the other hand, several species of parasitic or otherwise inimical invertebrates exhibit resurgent increases in population while others are destructive agencies with which the plants have to contend either continually or seasonally. Giant snails (Achatina species) feed voraciously in open woodland and grassland vegetation every year during wet spells - the wetter the season, the greater the damage. The destructive propensities of many invertebrates are factors to which the indigenous flora is probably fairly well conditioned in contrast to several of the exotic plants, which often suffer severe damage.

2.2 FISH

Fish and other forms of aquatic life are normally of little direct importance to the vegetation. The single exception will be discussed under subsection 3. MAN (below).

2.3 BIRDS

Whatever the influence of birds on the vegetation may once have been, their importance as factors in the plant environment appears to have been greatly reduced, especially in the Low Country. In the more inaccessible parts, especially at higher altitudes, bird life is richer and more examples of their influence are evident.

Birds exert a twofold influence on the vegetation. On the one hand, they promote the reproduction of certain plants by assisting in pollination and seed dispersal and by keeping insects and other flower- and seed-destroyers in check, as well as by keeping down the numbers of small plant-eating animals. On the other hand, birds are often responsible for the destruction of large quantities of seed. Many, if not most, of the birds found on Westfalia Estate appear to subsist on insects, frogs, fish and other small animals. The following account will be confined to a few of the more noteworthy instances of herbivorous, frugivorous, graminivorous and omnivorous birds.

Waterfowl are probably instrumental in the spread of aquatic plants into newly initiated hydroseral situations, e.g. Cyperus papyrus subsp. nyassicus?, while some, e.g. African or Red-Knobbed Coot [Fulica cristata Gmelin], play a part in controlling encroachment by the softer aquatic plants. On the other hand, plant distribution affects the distribution of waterfowl as, for instance, in the departure of the African Jacana or Lily Trotter [Actophilornis africanus (Gmelin)] from the Merensky Dam since the eradication of water-lilies, Nymphaea capensis, by fish (see subsection 3. MAN: P.49). Ducks and geese are infrequent.

Several species of doves occur. The Rameron or Olive Pigeon

[Columba arquatrix Temminck and Knip arquatrix] feeds on wild fruits and seeds. Phillips (1927) instances seeds of many species as being dispersed by this dove, e.g. species of Podocarpus, Olea, Cassine, Maytenus, Ocotea, Ekebergia and Rhus. Roberts (1958) mentions the fondness of this bird for the seeds of species of Calodendron, Ocotea and Olea. The common Cape Turtle Dove [Streptopelia capicola (Sundevall) capicola] eats seeds and grain, probably destroying far more seed than it distributes.

A subspecies of the Knysna Lourie, probably Turacus corythaix (Wagler) phoebus Neumann, occurs in the Grootbosch but probably only seldom ventures as far down as the Estate. The Purple-crested Lourie [Gallirex porphyreolophus (Vigors) porphyreolophus] found both in the Mistbelt and below it, tends to favour the scrub forest, scrub and more open vegetation rather than the secluded haunts of the Knysna Lourie. In addition to the seeds distributed by the Knysna Lourie and the Rameron Pigeon, e.g. species of Ficus, the Purple-crested Lourie may play a part in dispersing seeds of the larger fruits such as those of species of Harpephyllum and Parinari (Roberts, 1958) as well as of Aphloia, Rauvolfia and many others.

Black-eyed Bulbuls [Pycnonotus barbatus (Desfontaines) layardi Gurney] feed on fruit and insects. Red-winged Starlings [Onychognathus morio (Linnaeus) morio] eat a wide variety of fruits and seeds of species of most of the plant genera mentioned above. Van der Schijff (Unpubl.) refers to these two species as eating the seeds of Trichilia emetica. As these and other birds are probably attracted by the bright red fleshy arils displayed on dehiscence of the capsules of Trichilia spp., it seems likely that they also assist in the dispersal of these seeds, carrying them for some distance even when they do not eat them.

Small seed-eaters (ESTRILDINAE) as well as other seed-eating passerine birds are sometimes fairly frequent in Low Country grassveld, as well as in less-populated areas, e.g. Mannikins [Lonchura species], Cape Widow-bird [Coliuspasser capensis (Linnaeus) transvaalensis (Roberts)], Golden Bishop Bird [Euplectes afer (Gmelin) taha A. Smith], Firefinch [Lagonosticta rubricata (Lichtenstein) rubricata] and Common Waxbill [Estrilda astrild (Linnaeus) astrild]. Like doves, these small birds probably take a heavy toll of grass seeds, especially of PANICEAE, e.g. Panicum maximum and Setaria chevalieri, destroying far more than they disseminate.

In addition to ridding woody plants of many aphids and other small insects, Cape White-eyes [Zosterops pallidus Swainson virens Sundevall] help to disperse the seed of plants with small fruits, e.g. Trema orientalis.

As seed-dispersing agents, frugivorous birds have substantially assisted the recovery of the vegetation and promoted the course of succession since general conservation has been applied, e.g. in the spread of seed of several plants, such as Maesa and Rhus spp., into and from the Trema plantations. These birds are probably also responsible for an increase of Trema orientalis by dispersing seed from the Trema plantations (see also p. 44 and p.264 & 268).

Sunbirds (NECTARINIIDAE) are partly insectivorous but are probably of greater importance as pollinating agents to most of the plants whose flowers they visit in search of nectar, e.g. species of Erythrina, Leonotis, Aloe, Kniphofia and, possibly, Strelitzia. The efficacy of sunbirds in the pollination of Strelitzia flowers has recently been questioned (Skead, 1963). Double-collared Sunbirds [Cinnyris species] have been seen at the flowers of the epiphytic hemiparasitic Loranthus dregei.

Birds may be extremely important to some dependent plants in regard to seed dispersal: frugivorous birds, for instance, "plant" the seeds of epiphytic types of dependent plants in situ on potential supporting plants by wiping their sticky bills, with adhering seeds, on the stems and branches of trees after eating the fruit, e.g. Loranthus dregei, or the fleshy infructescence, e.g. Peperomia reflexa. The seeds of the hemi-epiphytic "strangler-figs" (Ficus craterostoma and F. petersii) may be planted in the same way, the presence of latex or some other source of stickiness in the receptacles resulting in the achenes sticking to birds beaks. The seeds of strangler-figs are probably more often sown in the droppings of birds and fruit bats, and they are also disseminated by monkeys. Birds are presumably also instrumental in the spread of the lianoid, hemi-epiphytic hemiparasitic Cassytha ciliolata and the facultatively epiphytic Clivia caulescens, which bear seeds in fleshy receptacles and berries respectively.

2.4 MAMMALS

The mammalian fauna, like the avifauna, has been much depleted and its influence correspondingly reduced. The influence of mammals, like that of birds consists largely in their dispersal and destruction of seed and in their preying on seed-dispersing and seed-eating or otherwise destructive animals. The nomenclature in the following account follows that of Ellerman, Morrison-Scott and Hayman (1953).

The several rodents and Insectivora are so effectively controlled by diseases, parasites, snakes, predatory birds and small Carnivora that their destructiveness is curbed and the vegetation does not suffer from excessive increases in their population. Both ground and tree squirrels have been observed but their influence on the vegetation appears to be negligible.

Like birds, fruit bats (viz. species of Eidolon and Epomophorus) are important in the seed-dispersal of numerous species of plants in this area, including Psidium guajava and other exotics. They are also agents in the dissemination of seed of Anthocleista grandiflora (S.C. McDonald, p.c.) and at least some species of Ficus and probably also of species of Cephalanthus, Eugenia and Syzygium amongst others.

Occasional bushbuck [Tragelaphus scriptus (Pallas)] and duiker [Sylvicapra grimmia Linnaeus] occur in the high forest and scrub forest areas where there is plenty of cover. Bushbuck are very partial to Acanthaceous undershrubs such as Justicia campylostemon and species of Hypoestes and Isoglossa, particularly I. delicatula which is heavily browsed when it is available in sufficient quantity (see p. 187).

Bush pig [Potamochoerus porcus Linnaeus], routing up the earth in search of edible roots, tubers, bulbs and root-stocks, do considerable damage to certain plants, especially the undergrowth of scrub forest, forest and scrub. At the same time, they promote plant reproduction and further succession in communities that are more or less closed or difficult of entry. They also assist in the dispersal of numerous species, probably including Clivia caulescens, both by seed and by vegetative propagation, as uprooted stems of this plant strike root easily. Relatively few of the seeds taken escape injury. Since the vegetation has been protected, bush pig have returned to the area with the advancing scrub and scrub forest.

In addition to the valuable part they play as predators in keeping down the numbers of insects, rodents and other pests, carnivorous animals, such as the VIVERRIDAE (the mongoose family), may sometimes eat fruit and so disperse seeds. Carnivora may also assist in the distribution of the seeds of parasites, as in the case of Sarcophyte sanguinea. The inflorescences of this root parasite look and smell like carrion and portions of the female inflorescence and infructescence may be carried over short distances and perhaps, on occasion, buried.

Baboons [Papio ursinus Kerr] have only been seen along the Rakgwale Ridge. Although they devour fruits and seeds and the subterranean storage organs of geophytes as well as numerous small animals, they appear so infrequently that they are practically of no account.

Vervet Monkeys [Cercopithecus aethiops Linnaeus] frequent the lower portions of the high forest and the near-climax woodlands and gallery forests down to the Lowveld. In the higher-level climax high forests, they appear to be replaced by Samango Monkeys [Cercopithecus mitis Wolf]. Both these monkeys live largely on fruit and seeds and are instrumental in the dispersal of the seeds of many of the plant species of their respective habitats. Such dispersal is probably only over short distances, as the seeds are often discarded after the fleshy parts or arils have been removed, e.g. Annona senegalensis, Parinari curatellifolia subsp. mobola, Strychnos spinosa, Syzygium cordatum, Trichilia emetica, T. dregeana, Syzygium gerrardii, Ensete ventricosum, Clivia caulescens and a host of others. Apart from dropping the seeds, fruits and vegetative parts of epiphytes, such as species of Ficus, Clivia, Peperomia and Asplenium, onto lower branches, facultatively epiphytic plants, for instance Clivia caulescens, Streptocarpus parviflorus and Asplenium aethiopicum, dislodged by monkeys, may take root on the forest floor. The advantages, with regard to seed dispersal, bestowed by monkeys on some species probably outweigh the disadvantages of their destruction of flowers, immature and ripe seed, and the damage they do to branches and other organs; but to other species they are merely destructive.

3. MAN

The direct and indirect influences of man on the vegetation of Westfalia Estate have been and remain manifold and far-reaching. A chronological account of the patterns and consequences of human occupation has been given in sections A and B of Chapter I. Accordingly, only the salient points regarding the effects of human occupation will be recapitulated here.

3.1 THE BANTU

(A) THE UTILISATION OF LAND AND NATURAL VEGETATION

1. The Bantu inhabitants were originally scattered throughout the area in small villages which were from time to time abandoned, and new villages set up. Their influence, as regards cultivated, abandoned and overgrazed land, was confined mainly to the immediate neighbourhood of the villages and kraals.

2. The practice of shifting cultivation and the unceasing demand for wood for fuel, building and other purposes resulted in the cutting out of most trees in the vicinity of kraals except for trees bearing edible fruit, particularly Parinari curatellifolia subsp. mobola. This removal of woody growth was not invariably effective and the hacking off of branches and shoots and the inefficient eradication of Acacia ataxacantha from the cultivated lands appears to have led to the inordinate increase of this species by coppicing and suckering.

3. Overstocking and the cultivation of crops on vulnerable sites, such as steep hillsides and marshy bottom-lands, led to soil erosion, landslips and desiccation.

4. The Bantu foraged farther afield for game and timber for various purposes, firing the veld to provide fresh grazing and to attract game for hunting.

These practices have undergone a marked change during and since the ownership of the Estate by Dr. Merensky.

(B) PLANTS PROPAGATED BY MAN

(1) Native Plants. A plant that appears to be indigenous locally but which is sometimes cultivated and found near kraals is the Cucurbitaceous *Momordica foetida*, greatly relished by the local Bantu as a spinach. *Erythrina lysistemon* is frequently grown by the Bantu from truncheons for ornament and for living fenceposts. *Oncoba spinosa* is also sometimes grown as an ornamental small tree or hedge plant and for the hard-shelled fruits used by the Bantu for making ankle-rattles. *Erythrina lysistemon* and *O. spinosa* sometimes indicate the sites of abandoned kraals. *Dodonaea viscosa* is often used as a hedge-plant and appears to occur elsewhere as an escape, as it is seldom found far from human habitation. It may therefore not be native locally although it is apparently indigenous in South Africa.

(2) Introduced Plants. The Bantu have undoubtedly introduced several species into the area although it is difficult to establish when such plants as maize (*Zea mays*) Jobs-tears (*Coix lacryma-jobi*), Kaffir corn (*Sorghum* sp.), ground-nuts (*Arachis hypogea*), njugo beans (*Voandzeia subterranea*), pigeon peas (*Cajanus cajan*) and "matabala" or Kaffir potatoes (*Coleus rotundifolius*) and certain Cucurbitaceae were introduced. In any event, none of these plants shows signs of escaping.

3.2 THE EUROPEANS

The influx of White settlers into the areas between the Bantu kraals and villages resulted in a somewhat chequered pattern of occupation and land-use. The results of White settlement are briefly discussed below.

(A) THE UTILISATION OF LAND AND NATURAL VEGETATION

1. The high forests were exploited for timber and much selective and sometimes heavy felling took place. This has upset the equilibrium in parts, resulting in a dearth of well-grown timber of valuable species and an abundance of less valuable timber.

2. The use of "pit traps" ("vangkuile") and periodic game drives probably greatly reduced the numbers of the game formerly found in the forests, while shooting rapidly diminished the amount of game outside the forests. The depletion of game in the forests probably favoured the regeneration of the much-exploited forests to some extent, since there would be less damage to young trees by trampling and browsing animals.

3. The mountain sourveld was grazed and burned, and overgrazing and selective grazing occurred at different times and different places.

4. Fruit and vegetables were cultivated on a small scale initially. Large-scale plantings were at first unsuccessful or uneconomic.

5. In the early days large tracts of arable land were used for cropping. This led to the rapid deterioration of soil structure and fertility, and to severe soil erosion which, with pests and parasites, rendered crop-farming hazardous and uneconomic.

6. The coming of the railway during World War I created accessible markets for timber and fruit, and the area was planted up on a large scale with timber plantations and orchards, especially on the less mountainous lower levels.

7. Since the 1930's, conservation methods have been implemented on a large scale at Westfalia Estate, allowing the vegetation to recover under protection, on sites not utilised for forestry and agriculture. Conservation work has included dam-building, contour-trenching and local reseeding and planting of indigenous trees (see p.44-5 , and p.251 et seq.). These practices have clearly had considerable effects on the composition of the vegetation and the course of succession, as will be borne out in the discussion to follow.

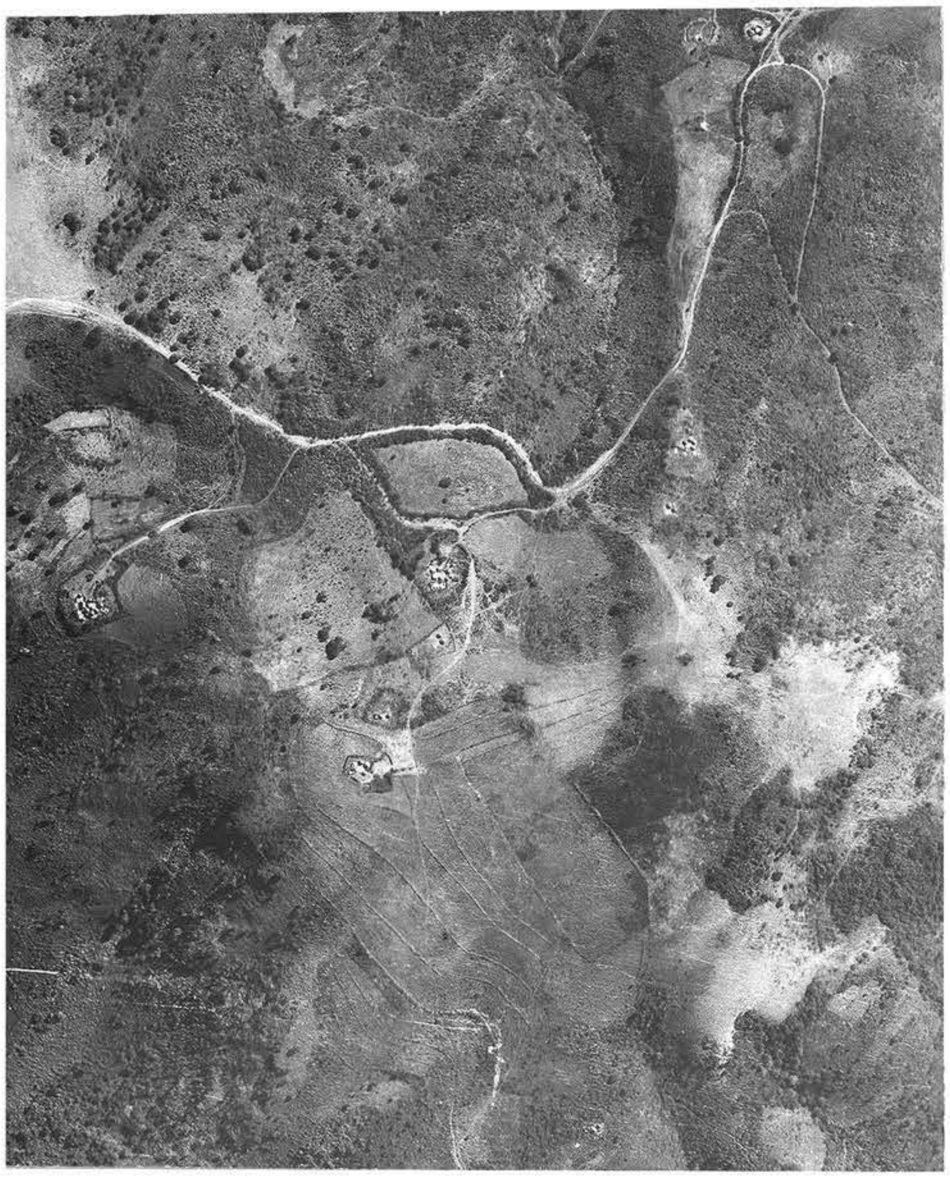


Plate 2(a) Central Hill in 1938 [Photo. Aircraft Operating Co. of Africa (Pty) Ltd., by courtesy of the S.A. Trigonometrical Survey Office.]

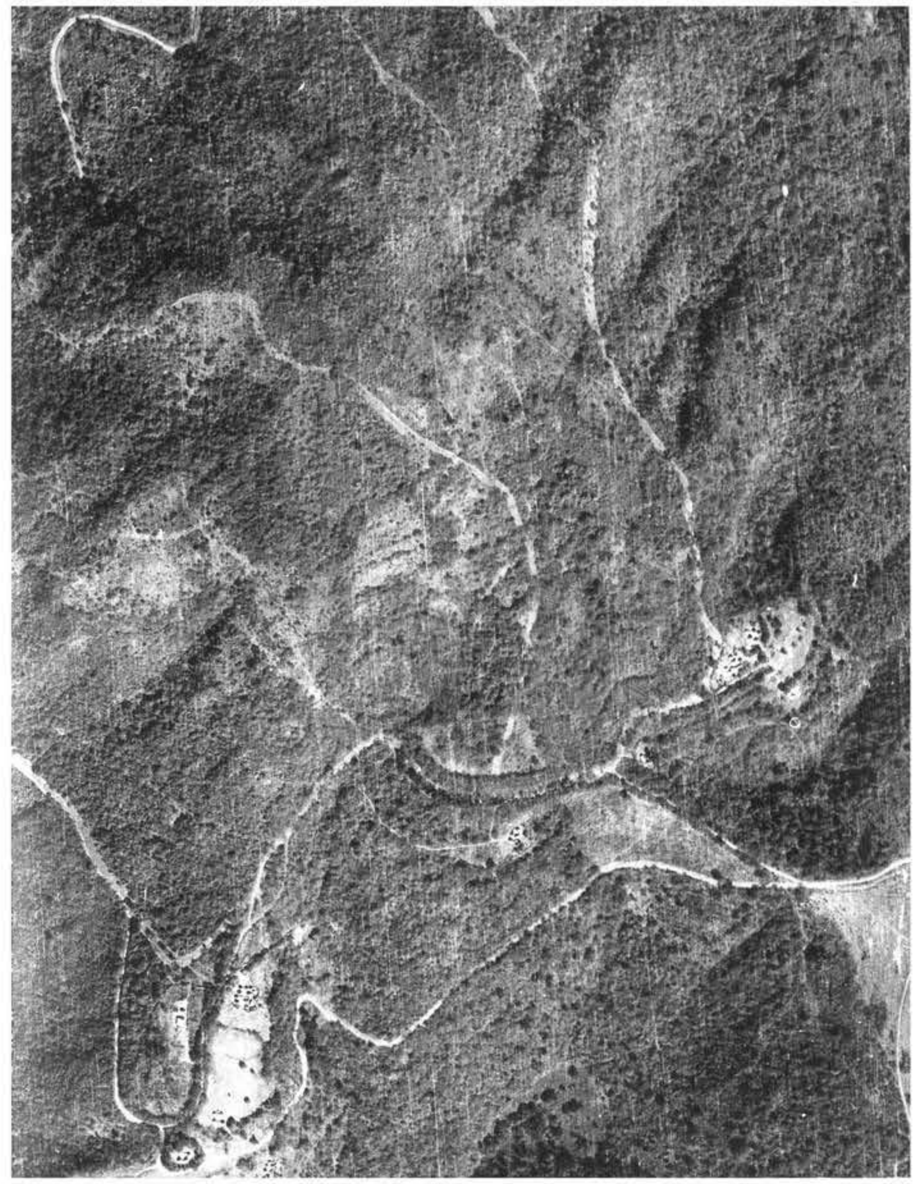


Plate 2(b) Central Hill in 1956, showing large-scale encroachment by Acacia ataxacantha and other species [Photo. Trig. Survey]

Plates 2(a) and 2(b) illustrate the changes that have taken place on Central Hill over a period of some 18 years. Note the livestock tracks, paths and other bared patches observable in Plate 2(a), as well as the extensive old crop-lands in the central and western (left) summit portion.

(B) PLANTS PROPAGATED BY MAN

(1) Native Plants. After the contour-trenching of Central Hill as part of the conservation programme, the following quantities of tree seeds were sown along the trenches by W.M. Botha towards the end of 1945:

Erythrina lysistemon	:	about 3175 g	(approx. 7 lb)
Maesa lanceolata	:	" "	"
Heteropyxis natalensis	:	" 2722 g	(" 6 lb)
Nuxia floribunda	:	" 2268 g	(" 5 lb)
Faurea saligna	:	" 907 g	(" 2 lb)

Some seedling trees were also planted along the contour furrows.

Early in 1946, about 2722 g (approx. 6 lb) of *Trema orientalis* seed was also sown on Central Hill (W.M. Botha, p.c.). These sowings do not appear to have been entirely successful but the hill does bear numerous trees of the above species which have evidently grown as a result. Seedling trees of *Maesa lanceolata* and *Trema orientalis*, with their precocious crops of small fruits, must assuredly have attracted frugivorous birds. These birds probably brought in seeds of *Antidesma venosum*, *Bridelia micrantha*, *Ficus capensis*, *Rhus* spp., *Syzygium cordatum* and others. These sources of seeds together with the spread of *Acacia ataxacantha*, *A. davyi*, *Antidesma venosum*, *Brachylaena transvaalensis*, *Bridelia micrantha*, *Combretum gueinzii*, *C. erythrophyllum*, *C. kraussii*, *Euclea crispa*, *Ficus capensis*, *Parinari curatellifolia* subsp. *mobola*, *Pittosporum viridiflorum*, *Rhus* spp., *Syzygium cordatum*, *Ziziphus mucronata* and other species, from the kloofs, and the regeneration from trees incompletely eradicated or left standing in the crop-lands, e.g. *Acacia ataxacantha*, *A. davyi* and *Parinari curatellifolia* subsp. *mobola*, can be held responsible for the aggressive and rapid way in which the Central Hill has been taken over by woody vegetation (cf. Plate 2).

The germination and growth of trees sown *in situ* were naturally slow, irregular and haphazard. At this time, the *Trema*-planting venture began with the establishment of a nursery for the large-scale propagation of *Trema orientalis*. *Trema* plantations were established on Christinasrust, in the Mistbelt, and below the Mistbelt, on the lower northern to eastern slopes of the Central Hill, until 1950 (Keet, 1962). Afterwards, about 4000 seedlings of other indigenous trees were grown for underplanting in the *Trema* plantations (S.C. McDonald, p.c.). The underplanting was confined to Compartment 12 of Christinasrust and the more important of the species planted there include *Brachylaena transvaalensis*, *Cussonia spicata*, *Anthocleista grandiflora*, *Podocarpus latifolius*, *Harpephyllum caffrum*, *Rauvolfia caffra*, *Rapanea melanophloeos*, Prunus africana and Bridelia micrantha. This underplanting continued until soon after Merensky's death.

The Trema plantations on the Central Hill were not underplanted with other indigenous trees except for some Syzygium cordatum, Rauvolfia caffra and a few Anthocleista grandiflora in the vicinity of seepages, marshy and swampy areas in Compartment W.W. by ex-forester W.M. Botha.

On both Central Hill and Christinasrust, numerous seedling trees and shrubs have infiltrated into the Trema plantations. Among the more important of these are Maesa lanceolata, Bridelia micrantha, Euclea crispa, Combretum gueinzii, Antidesma venosum, Rhus spp., Dombeya burgessiae, Heteromorpha trifoliata, Acacia ataxacantha and Allophylus transvaalensis.

Besides the underplantings of species of Syzygium, Rauvolfia and Anthocleista in Compartment W.W., several trees were planted in kloofs elsewhere on the Estate where trees had been cut out. These included Brachylaena transvaalensis, Rauvolfia caffra, Syzygium cordatum, S. gerrardii, Trema orientalis, Podocarpus latifolius, P. falcatus, Cryptocarya liebertiana, Croton sylvaticus and a few Adina microcephala var. galpinii and Harpephyllum caffrum. Podocarpus falcatus planted on top of Central Hill are growing but hardly thriving in the open, far from forest conditions. A small plantation of P. latifolius in the lowest part of the Mtataspruit valley in the Low Country is growing well but slowly, with excellent regeneration on the floor, probably owing to very favourable site qualities.

(2) Introduced Plants.

(2.1) Indigenous Plants. In the present context, "indigenous plants" means plants indigenous to other parts of South Africa but deliberately introduced into this area. The most conspicuous example of ecological effects resulting from such introductions is furnished by Echinochloa pyramidalis. A few cuttings of this robust semi-aquatic grass from the Lowveld were planted below the confluence of the Mtataspruit and the Ramadiepa River, to serve as a trap to prevent silt from entering the Merensky Dam downstream. This patch spread remarkably quickly to form a type of "aquatic grassland" (see Boughey, 1957) comparable to "Prairie á Echinochloa pyramidalis" of Léonard (1952). As a result of this, the course of the Ramadiepa River became indefinite at that point; the river spread across the width of the valley bottom. This aquatic grassland functioned as a very effective silt trap (see Plate 3).

Owing to the great volume of silt caught and held, the present provincial road bridge across the river is the third successive "bridge"

Plate 3. Ramadiepa River valley-bottom, looking downstream towards Merensky Dam. The foreground and middle distance are dominated by an almost pure stand of Echinochloa pyramidalis. Self-sown Eucalyptus sapling at left, Populus deltoides at right.

Plate 4. Young plantation of Populus deltoides established on drained alluvium, caught up by Echinochloa pyramidalis, some of which can be seen in the foreground fringing the channel of the Ramadiepa River.

to be built on this site. Its foundations stand on the previous bridge which, in turn, rests on the original causeway-bridge. As a result of the abnormally high cyclonic rainfall which occurred in early January, 1958, the Ramadiepa River tore a fairly deep channel through the accumulated silt. The resultant draining of the beds of E. pyramidalis below the bridge has greatly reduced the vigour of this grass, which has, however, stabilised the substratum to such an extent that it has been possible to establish a poplar plantation there (see Plate 4).

One of the most widely planted grasses on the Estate is Digitaria diversinervis ("Richmond grass") which is planted for lawns and was also planted on contour banks and the banks of loose earth below roads cut in the mountain-sides (e.g. Weltevreden-Enkeldedoorn) to hold the soil against erosion. This species is showing a tendency to escape in places.

Of the many introduced indigenous pasture grasses, only Chloris gayana appears to occur as an adventive along roadsides and other disturbed areas. It is, however, a widespread ruderal and may be native. Other strangers which may have been introduced indirectly are the Lowveld elements Cenchrus ciliaris and Securinega virosa, and possibly Eragrostis superba, which occur in the railway enclosure in the Lowveld Sour Bushveld Transition Zone.

Many tropical African and pan-tropical and subtropical ruderals appear to be extending their ranges southward as a result of human passage and activities such as roadmaking. It is not always clearly evident whether any particular species has been recently introduced or not. Cases in point are Eragrostis arenicola, Cyperus amabilis, Mariscus firmipes, Cassia occidentalis, Crotalaria spp., Dodonaea viscosa and Lefeburia sp. This uncertainty applies particularly to hydrophytes and helophytes, such as Cyperus papyrus subsp. nyassicus (see p. 35).

(2.2) Exotic Plants.

(a) Escapes from Cultivation. Several grasses introduced for pastures and soil conservation work have become naturalised. Paspalum urvillei from South America has a wide ecological amplitude and is now completely naturalised. Cynodon plectostachyus ("star grass") from East Africa is now found as a very aggressive troublesome and practically ineradicable weed, especially in the Low Country. The East African Digitaria scalarum ("Dunn's finger grass") is less aggressive and troublesome as it spreads less widely from seed but it is also difficult to eradicate. Pennisetum clandestinum ("Kikuyu" grass), also from East Africa, used in erosion-control work, spreads vegetatively. Fortunately no male plants appear to be present on the Estate or its control would be practically impossible.

The originally South American Psidium guajava ("guava") is now a pan-tropical weed. In common with the South American Passiflora edulis ("granadilla"), it is planted for the sake of its edible fruit and it is now a widespread escape. A bramble, Rubus sp. (Scheepers 750), may be an escape from cultivation or an escaped spontaneous hybrid or possibly an introduced weed.

The Australian eucalypts, especially Eucalyptus grandis, frequently occur as escapes in fairly early as well as later stages of the hydrosere (see Plate 3) and in xeroseral scrub and scrub forest. Scattered trees of the Australian Grevillea robusta ("silky oak") and the South American Jacaranda mimosifolia occur in seral scrub and scrub forest. Cedrela toona, the Indian "toon" - a timber and ornamental tree, is occasionally found as an escape. Seedlings, saplings and pole stages of Jacaranda mimosifolia and Cedrela toona and plants of the Brazilian Aristolochia elegans ("Dutchmans-pipe"), an escaped ornamental twiner, are sometimes locally abundant and troublesome in eucalypt plantations.

Axonopus compressus, the North-Tropical American "carpet grass", holds its own in very localised stands in moist disturbed grassland. It is claimed that natural reproduction from seed of the widely planted East African Pennisetum purpureum ("elephant grass", "Napier fodder") does occur, but I have seen no conclusive instance of this. The cultivated hybrid known as "Bana" (P. purpureumXP. typhoides) and possibly another hybrid of P. purpureum parentage are apparently sometimes self-sown. Introduced strains of Panicum maximum, e.g. "Rakob", occasionally seem to be self-sown or hybridised with local strains.

Eupatorium rugosum from North America is quite widely found, apparently as a garden escape, usually in moist, lightly shaded situations.

Fair-sized trees of the Central American Pinus patula, Carica papaya ("pawpaw") and Persea gratissima ("avocado") and the Asian Citrus spp. are occasionally encountered as escapes. Australian Acacia spp., especially A. mearnsii ("black wattle"), are to be seen locally as relics of cultivation. The South American Solanum seaforthianum ("potato creeper") and the North and Central American Euphorbia heterophylla and E. fulgens and Tithonia diversifolia have also been observed to grow as garden escapes. The South American Doxantha unguis-cati ("cats-claw creeper") has been seen as a garden escape in plantations. While it can hardly be looked on as a weed at present, it would be as well to utter a timely warning of the possible danger of its increasing and becoming troublesome in plantations.

(b) Weeds. In this context, "weeds" will usually denote exotic plants generally recognised as noxious weeds, but also other exotics associated with cultivation and disturbance that have apparently not escaped from cultivation locally.

Weeds are present in large numbers, both as to individuals and species. Investigation has revealed that much of the weed flora is of tropical and subtropical distribution. A noteworthy instance is that of *Capsicum frutescens*, a pan-tropical weed frequent in the Low Country but apparently only recorded as a weed from this part of South Africa.

Among the naturalised exotics, two species give particular cause for concern. A most aggressive and troublesome, noxious, spiny woody scrambler, *Caesalpinia decapetala* forms extensive impenetrable thickets and is extremely difficult to eradicate. While uncommon at present, the originally tropical American and now almost pan-tropical *Lantana camara* represents a serious potential danger as it is difficult to control, being widely spread by birds. No effort should be spared to eradicate these undesirable plants.

The wide variety of exotics more or less thriving on Westfalia Estate indicates in some measure the diversity of habitats found there. The considerable number of naturalised exotics of tropical and sub-tropical origin as well as of indigenous weeds common to the area and to neighbouring tropical territories bears witness to the general prevalence of sub-tropical conditions as outlined in the discussion of climate in this chapter and as further evidenced in the discussions of ecology and floristics in the succeeding chapters. The manifold weeds of disturbance found on the Estate further provide ample testimony that man has altered and is still influencing the vegetation to a very considerable extent.

(C) INTRODUCED ANIMALS

The influence of the usual domestic livestock has been considered under the influence of man. One other biotic factor introduced by man remains to be discussed.

After the completion of the Merensky Dam, the waters were stocked with several exotic species of fish, as well as with indigenous species. These fishes fed mainly on small animals, algae growing on the bottom and attached to aquatic phanerogams, and plankton. After the dam filled, water lilies (*Nymphaea capensis*) began to encroach on the open water at an alarming rate. It was feared that the succession would proceed so rapidly that the useful life of the dam would be considerably shortened. Furthermore, by shading the shallow waters, *Nymphaea capensis* would limit the growth of bottom-growing algae, to the detriment of the fish population. Accordingly, in 1958 some 2000 Red-breasted Kurper (*Tilapia melanopleura* A.Dum.) were released in the dam (W.E. Maddison, p.c.).

This tropical and sub-tropical African fresh-water fish feeds voraciously on phanerogamic aquatic plants. In a year or two, the sheets of *Nymphaea capensis* had been all but eradicated by this fish, which has ever since tended to counteract the course of succession by checking the spread of *Typha capensis*, *Scirpus inclinatus* and other Cyperaceae including even *Cyperus papyrus* subsp. *nyassicus*. The presence of this fish may be responsible for the apparent inability of *Potamogeton thunbergii* to colonise the Merensky Dam although the latter is found upstream in backwaters of the Ramadiepa River, where *T. melanopleura* apparently does not occur.

CHAPTER III

INTRODUCTORY NOTES ON THE VEGETATION

A. THE VEGETATION BELTS

The vegetation of Westfalia Estate can be regarded as being transitional between Acocks' (1953) North-Eastern Mountain Sourveld and his Lowveld Sour Bushveld. The climax vegetation of the North-Eastern Mountain Sourveld is evergreen high forest, whereas that of the Lowveld Sour Bushveld is deciduous or semideciduous savanna woodland or woodland, according to the Yangambi scheme of physiognomic classification of African vegetation types (Boughey, 1957; cf. also Hopkins, 1965).

The high forest of the Escarpment represents part of a formation which extends from the East African mountains along the Eastern Escarpment down to the Knysna forests, near to sea-level (several authors including Burtt Davy, 1935 & 1938; Pitt-Schenkel, 1938). It can thus be said that the Northeastern-Transvaal high forests are an attenuated southerly extension of the East African Mountain Forest Formation (see Chapter IX, p. 275-7). Different sections of this formation in different regions have been variously named as is evident from the synonymies given by Snowden (1933), Burtt Davy (1938), Pitt-Schenkel (1938), Hedberg (1951) and Boughey (1956).

It is customary to refer to vegetation of the higher altitudes of the larger mountains as "montane" vegetation. Thus the formation "Forests at high altitudes" ("Forêts de montagne") in the Yangambi scheme, including "Moist montane forest" and "Dry montane forest", could as well be referred to as "Montane forests". The formation "Forests at high altitudes" would seem to be roughly equivalent to the "East African Mountain Forest Formation" but more embracing in its geographical scope as its terms imply. With reference to the formation "Forests at high altitudes," Boughey (1957) also notes that "In South Africa this type may occur also at lower altitude".

Confusion in usage has prompted attempts to restrict the use of the term "montane" to a definite altitudinal range (e.g. Boughey, 1956). It is to be expected that the altitudinal zonation of vegetation on mountains would vary with latitude, exposure to wind and distance from the sea and also with the size of the mountain mass owing to the "Massenerhebung" effect (Richards, 1936 & 1952; Van Steenis, 1935). Consequently, no hard and fast rules of maximum and minimum elevations for the various zones can be expected to be applicable throughout. Accordingly, while the altitudinal limits of 2300 m to 3000 m proposed by Boughey (1956) for the "montane zone" may hold good for Tropical African mountains, no serious objections can, it seems, be raised against the application of the term "montane" in South Africa to a formation found at progressively lower levels southwards. For instance, in the Natal Drakensberg, the Montane Belt, as delimited by Killick (1963), lies below about 1830 m. This is in keeping with the accepted practice (see Hedberg, 1951) of regarding the timberline as the upper limit of the Montane Belt.

The entire area under consideration lies below the timberline. According to the accepted definition whereby the timberline is taken to be the upper limit of the Montane Belt, areas where the climax vegetation is high forest fall within the Montane Belt. Adamson (1938) has referred to the Northeastern-Transvaal forests as Montane Forest. He gives the lower altitudinal limit of the Montane Forests as approximately 1400 m, but adds that they come lower in the east than farther west and that the upper limits depend upon the heights of the mountains. In this account, the lower levels of the Montane or High Forest Belt are considered to average about 1200 m.

The Lowveld Sour Bushveld of Acocks is roughly equivalent to the Large-leaved Deciduous Woodland with Tall Grass ("Grootblarige Bladwisselende Bosveld met Lang Gras") described from the southeastern Kruger National Park by Van der Schijff (1958 & Unpubl.), more particularly the eastern portions such as the _Terminalia-Dichrostachys-Parinari_ Community from the Numbi area.

Below about 900 m elevation on Westfalia Estate, there occurs a transition zone similar to the Lowveld Sour Bushveld but with many outlying plant species from the higher rainfall areas to the west. Notable among the outliers not restricted to the riverbanks are plentiful _Dombeya burgessiae_, _Faurea speciosa_, _Ficus capensis_, _Smilax kraussiana_ and _Vernonia ampla_, with occasional _Anthocleista grandiflora_, _Brachylaena transvaalensis_, _Calpurnia aurea_, _Halleria lucida_, _Nuxia floribunda_ and _Rhoicissus tomentosa_. These outliers are associated with such Lowveld Sour Bushveld elements as _Albizia versicolor_, _Annona senegalensis_, _Combretum suluense_, _Dichrostachys cinerea_ subsp. _nyassana_, _Ehretia amoena_, _Ficus petersii_, _F. sycomorus_, _Piliostigma thonningii_, _Pterolobium exosum_, _Sclerocarya birrea_, _Secamone parvifolia_, _Steganotaenia araliacea_, _Terminalia sericea_, _Vernonia colorata_ and _V. crataegifolia_. These elements from the Escarpment slopes and the Lowveld Sour Bushveld are integrated into a kind of heterogeneous complex with the common _Parinari curatellifolia_ subsp. _mobola_, _Pterocarpus_ spp., _Faurea saligna_, _Bridelia micrantha_, _Combretum gueinzii_, _Heteropyxis natalensis_, _Peltophorum africanum_ and others. This complex is here called the Transitional

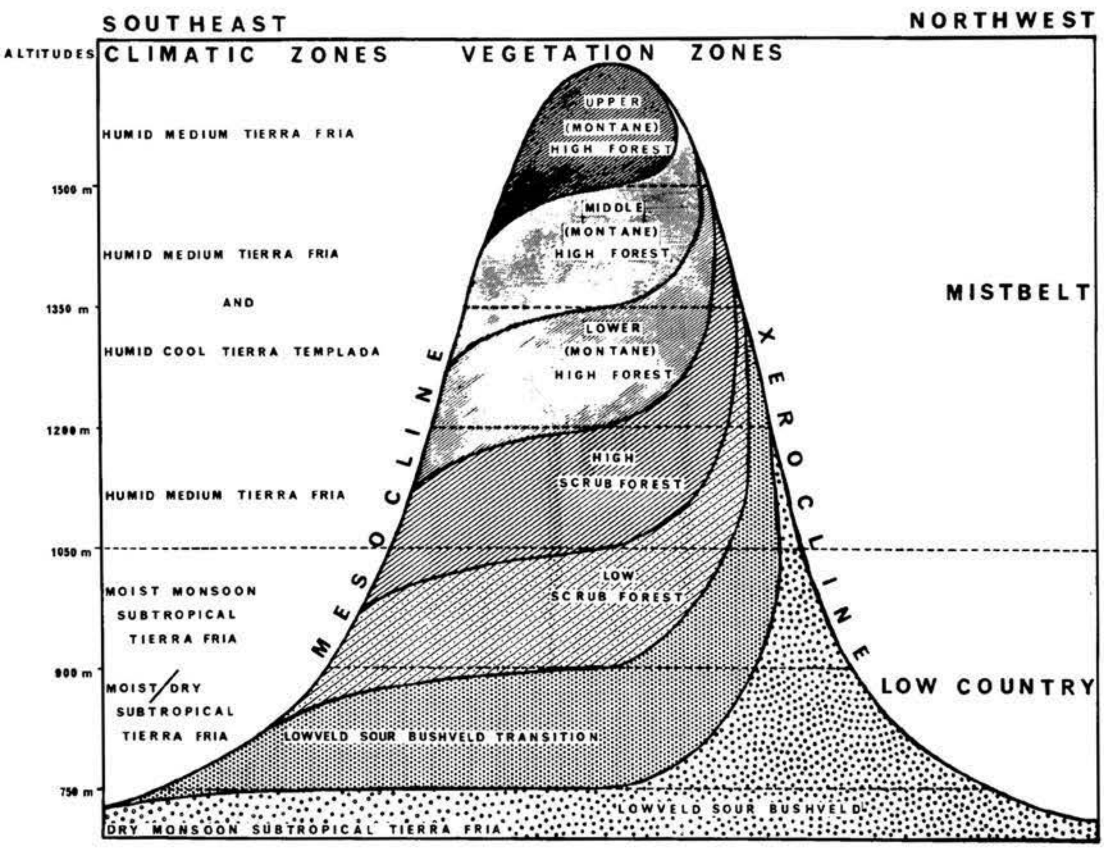


Fig. 5. Schematic representation of an idealised spur extending north-eastwards from the Escarpment. The purely hatched zones fall into the Mistbelt. Low-Country zones are stippled.

Lowveld Sour Bushveld or Lowveld Sour Bushveld Transition. It extends, for the most part, from 900 m down to about 750 m where the Lowveld Sour Bushveld is met with. This Lowveld Sour Bushveld Transition Zone of the Savanna Woodland Belt, once extensively cultivated for crops, is now largely planted up with timber plantations and orchards (see p. 7 <u>et seq</u>., and p.43). Apart from isolated relics, very little of the original vegetation remains.

Between the Montane High Forest Belt above about 1200 m, and the Savanna Woodland Belt below about 900 m, lies a tract of which the climax vegetation appears to be rather scrubby types of forest, closed-canopy woodland or scrub forests. This Scrub Forest Belt has been very much disturbed (see p.6) and, probably, almost nothing of the original vegetation remains except in isolated special edaphic situations, so that our concepts of climax vegetation have to be pieced together from scattered indirect evidence. This belt corresponds to the transition from the Mistbelt to the Low Country. The part lying in the Mistbelt is called the High Scrub Forest Zone, while the Low Country portion is called the Low Scrub Forest Zone. A clear-cut boundary between the High and Low Scrub Forest Zones is purely hypothetical because the Scrub Forest Vegetation Zones, like the climatic belts, grade into one another completely (cf. p. 31). However, for the sake of convenience, an arbitrary altitudinal boundary has been chosen varying mainly between about 1000 m and 1100 m in elevation, being depressed on the southern to eastern sides but raised on the northern to western sides. The interzonal boundaries may sometimes be raised to considerable heights on steep xeroclines, where rain-shadow effects come into play, as on the northern to northwestern slopes of Piesang Kop, where several Lowveld Sour Bushveld elements may be found above 1200 m (see p.113 et seq.).

The altitudinal distributions of the climatic and vegetation zones relative to one another, are illustrated in Fig. 5 , representing an end-on view of a typified spur of the Escarpment as seen from the northeast. The seres and climaxes of these vegetation zones, in their respective belts, will be discussed in the following chapters.

The average altitudinal ranges of the belts and zones dealt with in this account are given in Table 12 (p.34). To recapitulate, the vegetation belts as discussed in the following chapters are as follows:

1. Savanna Woodland Belt (below about 900 m)
2. Scrub Forest Belt (from about 900 m to about 1200 m)
3. High Forest (Montane) Belt (above about 1200 m).

B. PROCEDURE AND METHODS

Before commencing the descriptions of the actual communities, it is advisable to mention how the descriptions of the more complex communities, e.g. high forest, will be set out. The synusiae will be dealt with according to the following modification of the classifications given by Richards, Tansley and Watt (1940) and Richards (1936 & 1952):

(a) Emergent Tree Layer or Overstory: discontinuous where present

(b) Dominant Tree Layer or Canopy: normally continuous where present

(c) Subordinate Tree Layer or Understory: continuous or discontinuous, usually 2.5 m or more tall, where present

(d) Shrub Layer: shrubs (and giant herbs and ferns), stems (where present) usually less than 2.5 m tall

(e) Field Layer:

(i) Low Soft Shrubs, Undershrubs and Tall Subwoody Herbs and Ferns: usually between about 0.8 m and 2 m tall

(ii) Low Herbs and Ferns: (including species of *Lycopodium* and *Selaginella*) usually less than 0.75 m tall

(f) Ground Layer: bryophytes, where present

(g) Lianoid Plants:

(i) Lianes and Scramblers: robust and woody lianoid plants reaching the canopy, where present

(ii) Softer Slender Climbers and Scramblers: less robust, more herbaceous lianoid plants, not reaching the canopy, where present

(h) Hemi-Epiphytic Stranglers: certain *Ficus* spp.

(i) Epiphytes: including facultatively parasitic lichens, e.g. *Usnea* spp. (Phillips, 1929)

(j) Parasites: including hemiparasites

TABLE 13. Schedule of the physiognomic characteristics of the main vegetatio[illegible]nised and treated in this account.

Vegetation Type	Physiognomic Characteristics		
	Trees		Other Synusiae
	Canopy	Foliation and Other Characteristics	
Forest (Postclimax, Climax or Seral):	Closed	Predominantly evergreen. Overstory may or may not be present. Understory is typically present.	Shrub Layer may be well or poorly represented. Field Layer is typically present. Ground layer may or may not be present. Lianoid plants are typically present to abundant (especially in secondary forest). Epiphytes may be poorly to well represented.
Montane Forest	"	As above	As above
Upper Montane Forest	"	" "	Cryptogamic epiphytes abundant: especially bryophytes and lichens. Vascular epiphytes less frequent. Lianoid plants usually less frequent to occasionally abundant (especially in secondary forest). More temperate in character (e.g. Podocarpus spp. present).
Middle Montane Forest	"	" " Overstory and canopy trees buttressed	Vascular epiphytes infrequent to abundant: especially ferns. Epiphytic bryophytes and lichens fairly frequent to locally abundant. Lianoid plants usually more conspicuous than in Upper Montane Forest. Kiggelaria africana and Syzygium gerrardii frequent.
Lower Montane Forest	"	" " " " " " "	Lianoid plants usually more conspicuous than in Upper and Middle Montane Forest. Vascular epiphytes infrequent to abundant, especially ferns. Epiphytic bryophytes and lichens less conspicuous than above. Cryptocarya liebertiana and Trichilia dregeana frequent.
Riparian Forest *Riverine Forest	"	" " " " " " "	As above. Epiphytes abundant: especially ferns and bryophytes.
Riparian Forest Gallery Forest	"	Predominantly evergreen. Overstory and canopy trees buttressed.	" " " " : " orchids. Lianoid plants conspicuous.
Kloof Forest	Irregular	" " " " " " " "	Stratification obscured or poor. Epiphytes infrequent to abundant: especially ferns. Lianoid plants conspicuous and abundant. Shrub and field layers well developed under open canopy.
Cliff Forest	"	Predominantly evergreen.	Lianoid plants conspicuous and abundant. Shrub and field layers poorly developed.
Scrubby Forest (Seral)	Irregularly closed	" "	Lianoid plants conspicuous " ". Other synusiae may be well represented but stratification is much obscured by abundant transgressives: a transient stage.
Scrub Forest (Climax or Seral)	More or less closed	May be predominantly evergreen or semideciduous to deciduous. Tree layer uneven even if closed: Overstory and understory not clearly differentiated.	Other synusiae may be well represented but stratification is poor or obscured by lianoid plants and/or transgressives, especially in seral scrub forest. Lianoid plants are common to conspicuous. Epiphytes are usually uncommon or inconspicuous.
Savanna Woodland (Seral to Climax)	Open to closed	Rarely evergreen. Irregularly deciduous or predominantly semideciduous or deciduous. Emergents, where present, may be evergreen.	Stratification poorly developed or strata poorly represented except for dominant tree layer (or canopy) and field layer. Relatively few robust lianes and epiphytes are present but smaller lianoid plants may be quite common.
Scrub (Seral)	Fairly open to irregularly closed	Deciduous or semideciduous to evergreen depending on site. Trees are typically small with rounded crowns. Trees and large shrubs continuous.	Tree and shrub strata are not clearly differentiated. Other synusiae may be well represented but stratification is normally obscured by transgressive and lianoid plants which are commonly abundant (particularly Acacia ataxacantha).
Scrubby Grassveld (Seral)	Open	Trees and shrubs discontinuous, scattered to aggregated into "bush clumps". Deciduous or semideciduous to evergreen depending on site.	Shrubs and lianoid plants (especially Smilax kraussiana) may be well represented. Grasses predominate but forbs and ferns (notably Pteridium aquilinum) may be plentiful. Transgressive trees and shrubs may be quite common to abundant.
Grassveld (Seral)	"	Trees and shrubs absent or widely scattered: deciduous or semideciduous to evergreen depending on site.	Grasses predominate but forbs and ferns may be quite plentiful. Fully grown shrubs and, especially, lianoid plants and trees are typically poorly represented and inconspicuous but small transgressives may sometimes be quite common.

*In this context, "Riverine Forest" is riparian forest in areas where the climax vegetation is high forest. It is physiognomically similar to the normal "climatic-climax" high forest of its vegetation zone but differs in the relative densities of certain components and, to some extent, in species composition. It is characterised by mesic and hygrophilous species and, in this respect, resembles the "climatic-climax" forest of a more mesic vegetation zone. "Gallery Forest" denotes riparian forest in areas where the climax vegetation is of lower status than high forest, e.g. scrub forest or savanna woodland, and is, therefore, physiognomically distinct from the "climatic-climax" vegetation of its area. Although it may have numerous species in common with the "climatic-climax" it is characterised by the presence of more specific hygrophilous species which impart to it its distinct physiognomic aspect.

In addition to purely visual and other criteria (e.g. comparisons with the illustrations in Boughey, 1957), the nomenclature of vegetation types used in this account is defined in terms of physiognomic characteristics as represented in Table 13.

Unless otherwise stated, in the descriptions given in the following sections, the more important plant species of each community, synusia or zone are listed in descending order of abundance from the top to the bottom of the left-hand column and, thence, from the top to the bottom of the right-hand column. Whenever two or more species are approximately equally abundant, their names are arranged in alphabetical order.

Most of the important plants present are referred to specifically except for certain bryophytes and lichens which cannot easily be identified with certainty in the field. The Jungermanniales, so characteristic of the Mistbelt, were disregarded as being too difficult to identify even at the generic level. Among the phanerogams, juvenile stages of species of *Oricia* and *Teclea* are difficult to identify with certainty, but they were usually recorded as *Teclea natalensis*.

The names of introduced plants in the sense of p. 42 & 45 *et seq.*, are preceded by an asterisk, e.g. **Passiflora edulis*. Other symbols used are ↑ and ↓ for species tending to be more abundant upslope and downslope respectively, and the abbreviations N, E, S, W and their combinations for species tending to be more abundant on the north, east, south, west and intermediate aspects respectively.

The Clementsian system and terminology have largely been followed in the treatment of succession and in the arrangement and nomenclature of seral communities. This approach is considered to provide the most feasible and convenient framework for these purposes, and no adherence to Monoclimax concepts is intended or implied.

The descriptions of the different communities are based on data obtained by diverse methods. The most frequently used procedure employed "roughly cruised transects". Owing to the difficulties involved in laying out properly marked line or belt transects in most communities and the limited amount of time available, numerical abundance tallies were kept of all individual plants encountered in traversing one or more courses, at right angles to the contours and as straight as possible, through the sample of vegetation. These "roughly cruised transects" were undertaken where the vegetation seemed least disturbed and most typical. In view of the extensive plantations and other disturbed areas and the widely scattered relic nature of natural and near-natural plant communities, more objective methods were, with one exception (see Appendix A: p. 37 *et seq.*), deemed impracticable.

Stratified random sampling was adopted for studying the mountain sourveld glade lying on and north of the Madikeleni Catchment area in Rosendal. Twenty 10 m line transects were distributed at random along and at right angles to five contour lines previously pegged out at 100 ft (30.48 m) height intervals. While statistically inadequate to reveal the variations in composition within the glade, it was felt that this sampling method provided a sufficiently accurate picture of the composition of the glade as a whole (see p.37-9 , Appendix A). This glade, together with numerous other secondary communities, is described in Appendix A.

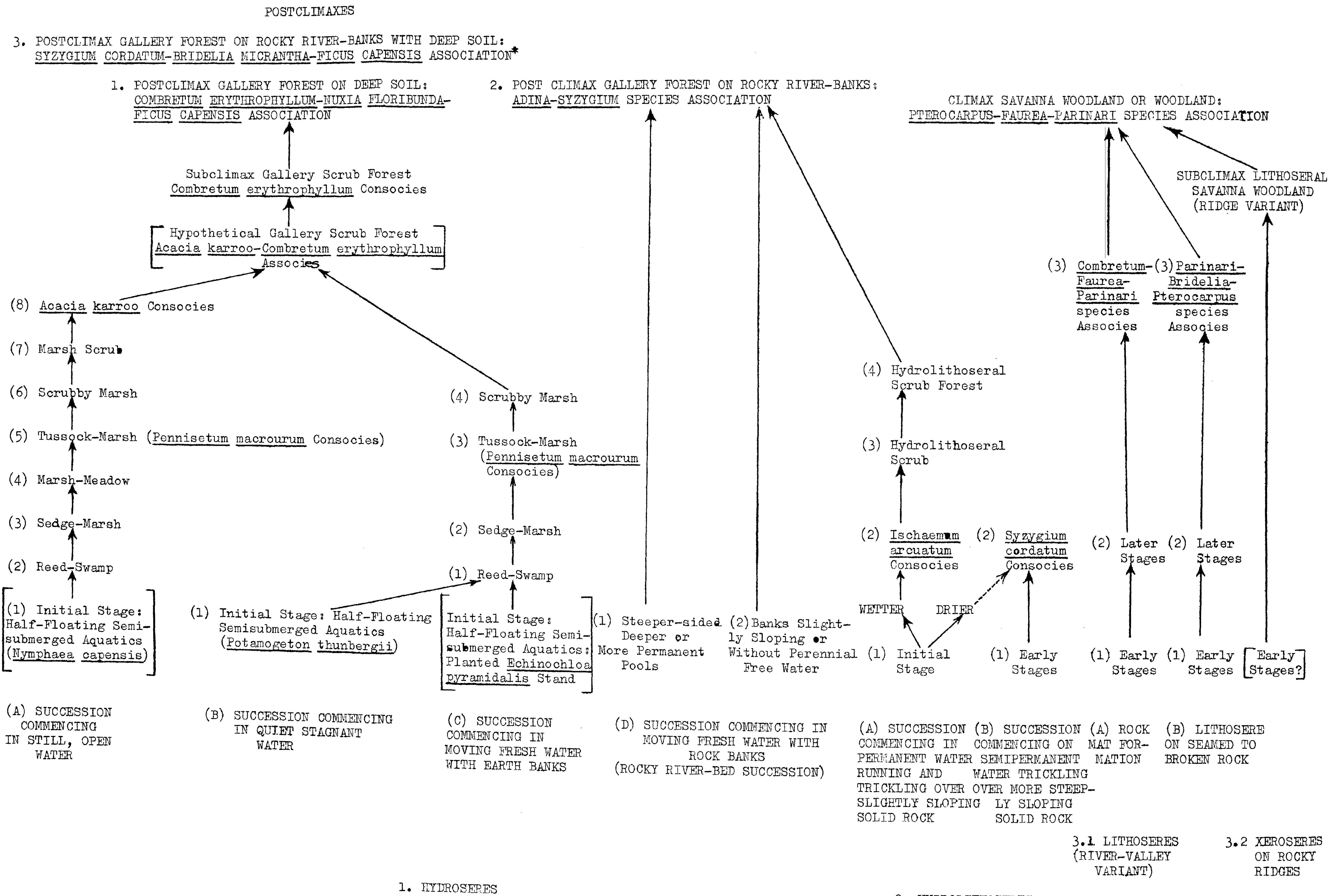


Fig. 6. Suggested successional trends and interrelationships of primary plant communities in the Lowveld Sour Bushveld Transition Zone. Communities enclosed in square brackets are hypothetical or can not be seen at present.

*3. Postclimax Syzygium cordatum-Bridelia micrantha-Ficus capensis Association is marginal to the Lower Scrub Forest Zone.

CHAPTER IV

THE SAVANNA WOODLAND BELT

The Savanna Woodland Belt is only represented on Westfalia Estate by the Lowveld Sour Bushveld Transition Zone of its upper levels.

THE LOWVELD SOUR BUSHVELD TRANSITION ZONE

The Lowveld Sour Bushveld Transition Zone extends from the Lowveld Sour Bushveld up to the Low Scrub Forest Zone of the lower foothills of the Escarpment. The altitude varies from about 750 m to about 900 m, with extensions and enclaves of Transitional Lowveld Sour Bushveld vegetation represented on xeroclines at higher elevations up to 1200 m and even more.

Being generally less undulating, and consequently more arable, this zone has been most intensively cultivated and planted up with orchards and plantations, particularly on the ridge slopes, while "mataka" lands have been cultivated in the valley-bottoms in places (see p. 7). Only disturbed and isolated relics of the original vegetation now exist, from which it is endeavoured to piece together a picture of the vegetation in the natural state. Very little of the remaining vegetation appears to approach a climax condition and most of the less-disturbed plant communities are clearly seral. The suggested successional trends and interrelationships of primary plant communities are indicated in Fig. 6.

A. PRISERES

1. HYDROSERES

The hydroseres differ appreciably according to whether the succession is initiated on still open water, stagnant water or moving fresh water. The last-named seres also vary, depending upon whether the stream-banks consist of soil or rock. Primary bare areas of seepage water trickling over solid rock constitute a special situation discussed under a separate head, viz. the "Hydrolithosere" (see p. 68 *et seq.*).

(A) SUCCESSION COMMENCING IN STILL OPEN WATER

The Merensky Dam is the most extensive body of water in the area and its banks and environs carry wide stretches of early hydroseral stages. Owing to the variable steepness of the banks, zonation can only be discerned with difficulty. Zones are often very much telescoped or absent altogether, where the transition from deep water to high banks is too abrupt. Later stages are poorly developed or absent and the nature of communities seral to swamp forest or gallery forest has had to be inferred to some extent because, since the building of the Merensky Dam, insufficient time has passed for their extensive development.

Since the introduction of Tilapia melanopleura (p. 49), water lilies are no longer important colonists of open water. Nevertheless, the following description presupposes that this were still the case, on the grounds that this was the natural condition and that it would still apply but for man's intervention. Proceeding from the free water to the banks and outwards, the following zones can be considered to represent successive stages of the hydrosere:

(1) Zone of Half-floating Semisubmerged Hydrophytes. Nymphaea capensis formerly colonised extensive stretches of open water, forming a discontinuous innermost fringe to the following zone, where a suitable rooting substratum was neither too deep nor too shallow. In addition to the anchored, half-floating semisubmerged hydrophytes, a number of casual, detached, and free-floating or attached, trailing, and half-floating facultative hydrophytes may be present. These include Floscopa glomerata, Polygonum strigosum, P. salicifolium, Leersia hexandra, Pycreus mundii, Commelina diffusa, Alternanthera sessilis, Echinochloa pyramidalis, Ludwigia palustris and Panicum glabrescens.

(2) The Reedswamp Zone. The second stage is represented by a zone of half-floating or semisubmerged anchored helophytes, sometimes colonising the Nymphaea zone. The constituents of this zone sometimes form large half-floating clumps or "sudds", "islands" or discontinuous fringes along the waters edge. This zone consists of Phragmites communis and Cyperus papyrus subsp. nyassicus (especially close by the Ramadiepa River inlet, see Plate 5), with Typha latifolia subsp. capensis and Scirpus inclinatus and, to a lesser extent, Cyperus fastigiatus and C. longus, where the water is sufficiently shallow. In addition to the free-floating or attached trailing facultative hydrophytes mentioned under zone (1) above, scrambling to erect species may grow attached to the clumps of reeds and Cyperaceae. Amongst the latter are Crassocephalum picridifolium, Thelypteris totta, Adenostemma perrottetii, Ethulia conyzoides, Dissotis canescens, Polygonum pulchrum, Ranunculus multifidus, Carex aethiopica, Cyperus fastigiatus, C. haspan, Epilobium salignum, Pennisetum macrourum, Combretum erythrophyllum and Mikania cordata (rarely).

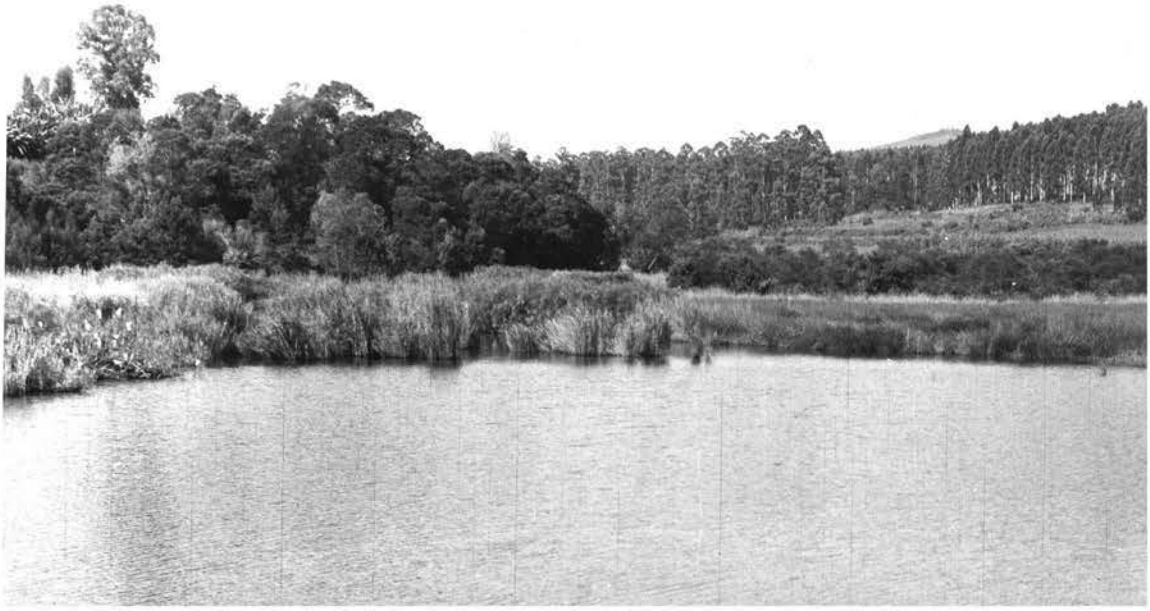


Plate 5. Merensky Dam in the vicinity of the Ramadiepa River inlet, with isolated clumps of Phragmites communis and Cyperus papyrus subsp. nyassicus and a fringe of these species with Scirpus inclinatus, Typha latifolia subsp. capensis and Cyperus spp. fronting deep water.

Plate 6. Hydrosere on Merensky Dam near the Motshunguludzi River inlet. Scirpus inclinatus fronting fairly shallow water in foreground. Early stages of Acacia karroo Consocies in background.

(3) The Sedge-Marsh Zone. This zone, dominated by Scirpus inclinatus, is usually well developed and the most extensive and clear-cut (see Plates 5 and 6). The dominant is accompanied by Cyperus latifolius, Typha latifolia subsp. capensis, scattered Phragmites communis, Leersia hexandra, Polygonum strigosum, P. salicifolium, P. pulchrum and Crassocephalum picridifolium with Thelypteris totta (locally subdominant). Less frequent are Cyperus longus, C. haspan, Cyperus sp.?* , Ischaemum arcuatum, Kyllinga melanosperma, Pycreus mundii, P. lanceus, Commelina diffusa, Hydrocotyle americana, Cyperus immensus, Pennisetum macrourum, Alchemilla rehmannii, Ranunculus multifidus, Stephania abyssinica and Epilobium salignum. On steep banks where the hydrosere is telescoped, Floscopa glomerata may also occur.

(4) The Marsh-Meadow Zone. This zone represents the fourth stage in the hydrosere where zonation is well developed. It is variously dominated by Cyperus latifolius, Ischaemum arcuatum and Kyllinga melanosperma. These three species, usually growing in almost pure stands, are often but not invariably found in the order given with increasing distance from the earlier stages. They are usually accompanied by Hydrocotyle americana and Alchemilla rehmannii, with numbers of Pennisetum macrourum, Cyperus fastigiatus and Thelypteris totta. Thelypteris totta is more plentiful away from the free water together with increased numbers of Stephania abyssinica, Commelina diffusa, Pycreus lanceus and Epilobium salignum. These are accompanied by Polygonum strigosum and P. pulchrum, with Scirpus inclinatus, Cyperus immensus and C. longus rapidly decreasing in importance away from the earlier stages along with occasional Leersia hexandra, Polygonum salicifolium, Crassocephalum picridifolium, Cyperus haspan, Pycreus mundii, Lysimachia ruhmeriana and Ranunculus multifidus, as well as isolated Thelypteris palustris var. squamigera, Dissotis canescens, Conyza ulmifolia and Phragmites communis. Thelypteris palustris var. squamigera may be locally important on the outer edge of this zone, while Lipocarpha senegalensis may sometimes be locally common on disturbed sites. Rhynchospora glauca may be locally frequent over very limited areas in the open. Also present are the more localised Scilla cooperi, Inula paniculata and Hibiscus trionum in a sheltered marsh-meadow, edging a quiet backwater by a seepage inlet, occasionally subject to fires from the railway enclosure.

(5) The Tussock-Marsh Zone (Pennisetum macrourum Consocies). The fifth stage is characterised by the conspicuous increase of Pennisetum macrourum together with Thelypteris totta and Stephania abyssinica.

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* Cyperus sp.?, cf. Mariscus elephantinus C.B.Cl. (= Scheepers 284)

Plate 7. Ecotone between Pennisetum macrourum Consocies and Acacia karroo Consocies. In foreground: Pennisetum macrourum and Thelypteris totta, with much Stephania abyssinica farther back. In background: Combretum erythrophyllum and Acacia karroo with Maesa lanceolata, Rhus intermedia and Rhoicissus tridentata.

Thelypteris palustris var. squamigera and Dissotis canescens are probably present in their maximum abundance in this zone. Simultaneously, Cyperus latifolius, Ischaemum arcuatum and, to a lesser extent, Kyllinga melanosperma decrease markedly in importance. Helichrysum mundii, Eulophia angolensis, Hemarthria altissima, Rubus sp. (Scheepers 750) and R. pinnatus may enter the sere at this stage. Hydrocotyle americana and Alchemilla rehmannii continue to be as important, accompanied by less Leersia hexandra, Cyperus haspan, Pycreus lanceus, P. mundii, Commelina diffusa, Lysimachia ruhmeriana, Ranunculus multifidus, Conyza ulmifolia and occasional Crassocephalum picridifolium with isolated Phragmites communis.

Pennisetum macrourum develops large tussocks which form better-drained miniature "hummocks" when the tufts become moribund and die. These miniature "hummocks" may then sometimes be colonised by woody plants thus forming nuclei of the next stage of succession.

(6) The Scrubby Marsh Zone. This fleeting transitional stage is typified by the entry and progressive rapid increase of woody plants, predominantly Rubus sp. (Scheepers 750) and R. pinnatus. The Rubus spp. are accompanied by Combretum erythrophyllum, Diospyros lycioides subsp. sericea, Maesa lanceolata, Rhus intermedia, Acacia karroo, Euclea crispa, Pittosporum viridiflorum, occasional Rhus transvaalensis and even Hypericum revolutum. H. revolutum does not thrive here, being weakened and infested with scale insects. There is a further increase of Stephania abyssinica and a decrease in importance of Hydrocotyle americana, Alchemilla rehmannii, Pennisetum macrourum and Thelypteris totta, while T. palustris var. squamigera is rare to absent. Conyza ulmifolia and Dissotis canescens also become progressively less frequent as succession proceeds.

Helichrysum mundii is present in its maximum abundance in the earlier stages of this zone accompanied by decreasing quantities of Leersia hexandra, Cyperus haspan, Pycreus mundii and other species of the fifth stage.

(7) The Marsh-Scrub Zone. This zone is marked by the rapid increase of Acacia karroo, Combretum erythrophyllum and, to a lesser extent, Pittosporum viridiflorum and Euclea crispa. Rhus intermedia continues to be approximately as abundant as in the previous stage together with occasional R. transvaalensis. Stephania abyssinica is an abundant twiner in this initial stage (see Plate 7). There is a simultaneous decrease in Rubus sp., R. pinnatus, Hydrocotyle americana, Alchemilla rehmannii, Helichrysum mundii and Diospyros lycioides subsp.

sericea. Infrequent associated plants are Leersia hexandra and other species of previous stages, excepting Hypericum revolutum which does not persist.

The inner edges of the zone corresponding to the next stage (Acacia karroo Consocies) are dominated by Acacia karroo accompanied by Combretum erythrophyllum, Euclea crispa and Pittosporum viridiflorum with abundant Stephania abyssinica. Associated small trees and shrubs include Rhamnus prinoides, Maesa lanceolata, Canthium huillense, Acacia ataxacantha, Rhus intermedia, R. transvaalensis, Lippia javanica, Diospyros lycioides subsp. sericea, Vernonia ampla, with transgressive Bridelia micrantha and Ziziphus mucronata, and isolated transgressive Anthocleista grandiflora. Examples of the herbaceous associates are Pavonia columella, Leersia hexandra, Setaria sphacelata, Paspalum commersonii, *P. urvillei, Alchemilla rehmannii, Hydrocotyle americana and occasional Crassocephalum crepidioides.

(8) Acacia karroo Consocies.

(8.1) Structure and Composition. This community is a dense closed-canopy woodland consisting of the following synusiae:

(a) Overstory. Few emergent trees occur and these are mostly Acacia karroo (7.5 m to 9 m tall) and, occasionally, Anthocleista grandiflora (9 m tall and more).

(b) Canopy. The canopy is more or less closed but irregular in height reaching up to about 7.5 m in places. It is dominated by Acacia karroo, with Canthium huillense (up to about 6 m tall) and Combretum erythrophyllum (up to about 7.5 m tall) subdominant. The more abundant associated trees include Pittosporum viridiflorum, Euclea crispa, Maytenus heterophylla, Ziziphus mucronata, Rhus intermedia, Ficus capensis, Acacia ataxacantha and Maesa lanceolata.

(c) Understory. Apart from potential canopy trees, a true understory is not developed and the woody undergrowth other than shrubs consists mainly of transgressives of which Bridelia micrantha, Euclea crispa, Maytenus heterophylla, Rhus intermedia, Maesa lanceolata and Kiggelaria africana are among the most important.

(d) Shrub Layer. The more abundant shrubs include Vernonia ampla, *Cassia laevigata, Lippia javanica and Diospyros lycioides subsp. sericea with Leonotis dysophylla in the better-illuminated spots. Numerous transgressive small trees, particularly Bridelia micrantha and Clausena anisata, are also present.

(e) Field Layer. This stratum is, in this instance, more conveniently subdivided into growth-form sublayers than dealt with according to the usual schema. Four such subclasses are recognised:

(i) Undershrubs and Suffrutescent Forbs. These may be locally fairly frequent, including Pavonia columella, Asparagus virgatus and Schistostephium heptalobum, with Triumfetta pilosa vars. and T. rhomboidea conspicuous in sunnier situations near the edge.

(ii) Taller Softer Forbs. With the exception of grasses and sedges, herbs occur infrequently. The more frequent species present are Haemanthus magnificus, Crassocephalum crepidioides, Cynoglossum lanceolatum and Lapeirousia grandiflora, with Agrimonia odorata and Ranunculus multifidus in better-lit spots near the margins.

(iii) Grasses and Sedges. Grasses and sedges dominate the floor. The dominant Oplismenus hirtellus is accompanied by Carex spicato-paniculata together with Kyllinga cylindrica and Cyperus albostriatus, with Cyperus haspan, Paspalum commersonii, *P. urvillei and Setaria sphacelata in better-illuminated situations especially near the edges.

(iv) Low Herbs. The prostrate herbs Hydrocotyle americana, Alchemilla rehmannii and Dichondra repens characterise the more open margins of the community.

(f) Lianoid Plants. Typical woody scramblers are Rubus pinnatus, Rubus sp. (Scheepers 750), Rhoicissus tridentata and Grewia occidentalis, while the robust climbers *Passiflora edulis, Smilax kraussiana and Clematis brachiata also occur fairly frequently. Less robust softer climbers are fairly frequently encountered. These include Cyphostemma cirrhosum subsp. transvaalense, Cissampelos torulosa, Rhynchosia caribaea, Coccinia adoensis, Melothria punctata and Momordica foetida, with Stephania abyssinica in the sunnier situations.

(8.2) Ecological Notes. It can be noted here that several common riparian trees of the Lowveld, e.g. Ficus sycomorus and Trichilia emetica, are absent from riparian and other river-valley sites in the Lowveld Sour Bushveld Transition Zone although they may occur higher up on the ridge slopes (see p. 86), as well as being widely distributed in the Lowveld Sour Bushveld. This may be because the valley-bottoms are more liable to frost as a result of cold-air draining into them more rapidly than out of them (see p. 26). Other factors such as poor drainage and aeration may also be involved here. In any event, the frost-hardy *Acacia karroo* and *Combretum erythrophyllum* (see also p.64-6) assume a greater importance in the frosty river-valleys of the Lowveld Sour Bushveld Transition Zone than anywhere else in the area under consideration.

The *Acacia karroo* Consocies described here is apparently undergoing a rapid change towards a type of subclimax riparian forest, probably to be composed largely of *Combretum erythrophyllum* (especially near the water), *Pittosporum viridiflorum* (especially away from the water), *Acacia ataxacantha*, *A. karroo*, *Bridelia micrantha* and *Ficus capensis*.

Anthocleista grandiflora and *Bridelia micrantha* appear to be on the increase together with such high forest trees as *Kiggelaria africana*, *Nuxia floribunda*, *Brachylaena transvaalensis* and, possibly, *Prunus africana*, in addition to *Syzygium cordatum*, *Halleria lucida* and *Allophylus transvaalensis*. The succession thus seems to be tending in the direction of postclimax riparian forest developed on moist soil banks (see p.92-6).

(B) SUCCESSION COMMENCING IN QUIET STAGNANT WATER

This sere has developed as a result of the ponding of the Ramadiepa River just above the Mtatasspruit confluence, owing to the choking of its course with **Echinochloa pyramidalis* and silt (see p.45-6) and the consequent raising of the bridge just below the confluence. The sere, which has not proceeded further than the sedge-marsh or marsh-meadow stage, appears to be essentially similar to the initial hydroseral stages on Merensky Dam. Salient points of difference are the absence of *Nymphaea capensis* and *Cyperus papyrus* subsp. *nyassicus*, and the presence in their stead of *Potamogeton thunbergii* colonising the free water. The absence of *P. thunbergii* from Merensky Dam is difficult to account for except by attributing it to chance. Since the Ramadiepa River scoured a channel through the natural filter of **E. pyramidalis* in 1958, it seems reasonable to suppose that disseminules of *P. thunbergii* will since have been swept down into the Merensky Dam. Perhaps the presence of *Tilapia melanopleura* has prevented any effective establishment of *P. thunbergii* in Merensky Dam (see p. 49).

The upper reaches of the Ramadiepa River are very sluggish and choked with *Phragmites communis*, *Typha latifolia* subsp. *capensis* and

Plate 8. Ramadiepa River marshes upstream of Merensky Dam. Eucalypt plantations in background with Acacia karroo and stand of *Echinochloa pyramidalis in far distance.

numerous Cyperaceae (cf. (C) below). Where water movement is obstructed, much stagnation results with great increase in quantity of iron bacteria and great local increase in importance of such species as Gunnera perpensa and Thelypteris totta with, sometimes, Sesbania macrantha var. levis and T. palustris var. squamigera.

(C) SUCCESSION COMMENCING IN MOVING FRESH WATER WITH EARTH BANKS

This type of succession is found along the long slow-moving stretches of the upper reaches of the Ramadiepa and Selukwe Rivers (see Map, opposite p. 3, and Plate 8). The zonation of the vegetation of the marshy environs of these stretches is similar to that of the vegetation colonising stagnant water. These stretches of the above streams have very wide shallow beds choked with vegetation through which the single or braided channels meander. Where vegetation obstructs water movement sufficiently, iron bacteria may be locally abundant in colonies wherever the water is not too deep.

Apart from the half-floating, almost pure stand of *Echinochloa pyramidalis established just below the confluence of the Mtataspruit and Ramadiepa Rivers and the very localised and locally common Salix woodii in the initial seral stages in the Selukwe River channel, the following short and very incomplete account of the zonation could apply almost equally well to both rivers.

(1) The Reedswamp Zone. Phragmites communis with Scirpus inclinatus and occasional Typha latifolia subsp. capensis, together with half-floating Leersia hexandra and Polygonum strigosum fringe free water.

(2) The Sedge-Marsh Zone. Reedswamp is succeeded by a zone of Scirpus inclinatus and Cyperus spp. (notably C. immensus, C. latifolius and C. longus) with occasional Alchemilla rehmannii, Hydrocotyle americana, Crassocephalum picridifolium, Kyllinga melanosperma, Polygonum salicifolium and P. strigosum, with the addition of an occasional labiate (Mentha aquatica?) in the Selukwe River swamps.

Cyperus immensus and C. latifolius may often grow in patches of considerable extent. These, however, bear no resemblance to a meadow and are rather to be regarded as sedge marsh.

(3) The Tussock-Marsh Zone (Pennisetum macrourum Consocies). A Pennisetum macrourum zone is well developed along the marshy banks

of the Ramadiepa River. No such distinct zone is found along the Selukwe River where, however, a dense hygrophilous grassland is developed, composed of Ischaemum arcuatum, Cyperus spp., Hemarthria altissima and *Paspalum urvillei. This zone merges into a less hygrophilous grassland of Hemarthria altissima, Paspalum commersonii, *P. urvillei and Hyparrhenia spp. Acacia karroo, which may already be present in sedge marsh, appears to increase in number at this stage along the Selukwe River.

(4) The Scrubby Marsh Zone. Owing to disturbance, further hydroseral stages are poorly represented along the Selukwe River. The transitional stages leading to the Acacia karroo Consocies, Acacia karroo-Combretum erythrophyllum Associes or Combretum erythrophyllum Consocies, which would, presumably, eventually follow the sedge marsh, are not clearly evident here.

Along the upper Ramadiepa River, two stages of hygrophilous scrub can be discerned. Following on the Pennisetum macrourum Consocies, a discontinuous bramble zone, with much Rubus pinnatus and other species, including an occasional Acacia karroo and abundant *Cynodon plectostachyus, is encountered. Both these zones may give way on the dry-land side to a fairly continuous zone dominated by Lippia javanica. Additional species present are Combretum erythrophyllum, *Cassia laevigata and Acacia karroo. The last-mentioned zone is probably largely secondary.

(5) Combretum erythrophyllum Consocies. This "gallery scrub forest" community can be seen along the northwestern banks, i.e. on the Fredericksdal side, of the Motshunguludzi Stream, near where it discharges into the Merensky Dam, close to the sand-diggings (see Appendix A, p.5).

(5.1) Structure and Composition. The canopy of this community is closed and irregular in height, varying mostly between 6 m and 9 m. The dominant trees are seldom erect and branch fairly low down with spreading rounded crowns. The following five synusiae can be recognised fairly easily:

(a) Canopy. Where the community is fully developed, the canopy is dominated by Combretum erythrophyllum with Acacia karroo subdominant, although these rôles are reversed in previous and transitional seral stages. Associated with these trees is the subscandent Acacia ataxacantha, accompanied by *Grevillea robusta, *Jacaranda mimosifolia, Pittosporum viridiflorum, Ziziphus mucronata, Rhus intermedia, Trema orientalis, occasional Bridelia micrantha, Dichrostachys cinerea subsp. nyassana and Halleria lucida, with isolated Antidesma venosum usually some distance away from and isolated Buddleia salviifolia more confined to the stream-banks.

(b) Shrub Layer. True shrubs are rather rare in this community. Apart from the shrubby subscandent Rhoicissus tridentata and Rubus spp., the more abundant shrubby plants up to about 2 m tall are Vernonia ampla and the subscandent Rhamnus prinoides, accompanied by occasional Diospyros lycioides subsp. sericea, Lantana mearnsii, Leonotis dysophylla, Lippia javanica, Pycnostachys urticifolia and very occasional Vangueria infausta. The ericoid shrubs Cliffortia nitidula var. pilosa and Hypericum revolutum are outlying Mistbelt elements occurring infrequently along the stream banks in the open and along the edges of this community.

(c) Field Layer. The field layer, up to about 1 m tall, can be subdivided into two sublayers differing in habit, height and degree of woodiness, as follows:

(i) Low Soft Shrubs, Suffrutices and Tall Subwoody Herbs and Ferns. But for the dominant, this sublayer is only slightly better developed than the true shrub stratum. The dominant Asparagus virgatus is accompanied by Stachys grandifolia, Hypoestes sp.? (H. aristata?), Pavonia columella, Phaulopsis imbricata and Pteridium aquilinum, with occasional *Physalis peruviana and Pouzolzia parasitica. The mesophytic riparian-scrub or forest form of Sida rhombifolia is locally fairly frequent along the stream banks, both under the canopy and in the open.

(ii) Low Herbs and Ferns. This subclass, as well as the field layer as a whole, is dominated by Oplismenus hirtellus. This grass is accompanied by Setaria chevalieri, Pellaea viridis, Sporobolus fimbriatus var. latifolius, Achyranthes aspera, Agrimonia odorata, Carex spicato-paniculata, Lapeirousia grandiflora, Sporobolus pyramidalis and Zantedeschia tropicalis, with occasional Commelina diffusa, Eulophia streptopetala, Haemanthus magnificus and Panicum maximum.

The following more or less herbaceous species also occur, often gregariously, on alluvial soil along the stream banks, partly in the open or partly under the canopy of the Combretum erythrophyllum Consocies, the transitional C. erythrophyllum-Acacia spp. Associes or the Acacia karroo Consocies (see p. 60):

Crassula thorncroftii
Ischaemum arcuatum
Hydrocotyle americana
Centella coriacea
Polygonum strigosum
P. pulchrum (in the open)
Ranunculus multifidus

Thelypteris totta
Alchemilla rehmannii
Cyperus haspan
Impatiens duthieae
Selaginella kraussiana
Pennisetum macrourum
Phragmites communis

(d) Lianoid Plants. Woody lianes and scramblers capable of reaching the canopy are not very strongly represented. Scrambling Acacia ataxacantha is fairly numerous, associated with Smilax kraussiana and accompanied by *Passiflora edulis and Rubus pinnatus, with occasional Adenia gummifera, Mikania cordata and Sphedamnocarpus galphimiifolius. Rhoicissus tridentata which is variously erect and sprawling to scrambling may also occur here as a rather short liane only reaching the canopy where the latter is low.

Smaller softer twiners and tendril climbers are of fairly frequent occurrence. The most abundant species is Cissampelos torulosa, associated with Senecio deltoideus and accompanied by Coccinia adoensis, Dioscorea retusa, Adenia digitata, Glycine javanica, Mucuna coriacea, Riocreuxia torulosa and Solanum bifurcum, with occasional Ceropegia setifera, Cyphostemma cirrhosum subsp. transvaalense, Gloriosa superba? (or Littonia modesta?), Rhynchosia caribaea, Stephania abyssinica and isolated Cayratia gracilis, together with occasional Ceratiosicyos laevis along the stream-bank.

(e) Parasitic Plants. The only heterotrophic plant observed was the scrambling shrubby Osyridicarpos schimperianus, hemiparasitic on roots.

(5.2) Ecological Notes. To judge by the number of transgressive trees of various species, it would seem that certain trees are on the increase, probably eventually at the expense of the present dominants. Notable in this respect is Pittosporum viridiflorum. Also important are Acacia ataxacantha, Bridelia micrantha, Rhus intermedia, Celtis africana, Maytenus heterophylla, Ziziphus mucronata, Rhus transvaalensis and, to a lesser extent, Allophylus transvaalensis, Euclea crispa and Ficus capensis.

The indications are that this community is developing towards the type of gallery forest found on deep soil banks fronting still water (see p. 92) where Combretum erythrophyllum is less important except at the waters edge.

Plate 9. Pool in Ramadiepa River below rapids and falls, downstream of Merensky Dam. Gallery forest of Adina microcephala var. galpinii, Syzygium cordatum, Anthocleista grandiflora and Ficus capensis in background. Secondary Syzygium cordatum Consocies at upper right.

(D) SUCCESSION COMMENCING IN MOVING FRESH WATER WITH ROCK BANKS (ROCKY RIVER-BED SUCCESSION)

The initial stages of the hydrosere on rocky river-banks vary considerably in density and species composition according to whether the rock banks vary from nearly level to steep and whether the water-level is variable or almost permanent.

(1) Rocky River-Bed Succession: Steeper-sided, Deeper or More Permanent Pools. Where the water is deeper and more permanent, a very mixed waterside community without clear dominance may develop. This habitat is found along the Ramadiepa River, downstream from the Merensky Dam, by the sides of pools and where the banks are steeper and sometimes with water trickling over the rock and down crevices. The more frequent constituents include the following:

Andropogon eucomus
Ischaemum arcuatum
Dissotis canescens
Floscopa glomerata
Leersia hexandra
Lipocarpha senegalensis
Pennisetum macrourum
Rhynchospora glauca
Thelypteris palustris var.
Xyris rehmannii

Bulbostylis boeckeleriana forma
Carex aethiopica
Conyza ulmifolia
Crassocephalum picridifolium
Fimbristylis dichotoma
Helichrysum mundii
Juncus brevistylis
Phragmites communis
Scirpus inclinatus
Senecio inornatus

The indications are that this stage is followed by a community composed largely of *Ischaemum arcuatum*, with *Dissotis canescens*, *Rhynchospora glauca*, *Crassocephalum picridifolium*, *Lycopodium cernuum* and *Thelypteris palustris* var. *squamigera*, together with trees of *Syzygium cordatum*, *Adina microcephala* var. *galpinii* and *Bridelia micrantha*. By increasing in size and number, these trees will, presumably, eventually give rise to gallery forest. Farther away from the river-banks, the succession is more likely to follow the course of the lithosere (see p. 77 *et seq.*) where the rock surface is dry. Where seepage water trickles over the rock surface, the succession rather resembles that referred to as the "hydrolithoseral" (see p. 68 *et seq.*).

(2) Rocky River-Bed Succession: Banks Slightly Sloping or Without Perennial Free Water. The succession on rocky river-banks without perennial free water is distinctive in that the pioneers are not exclusively aquatic or hygrophilous plants except for casual species which die from time to time, owing to periods of low water when the rock

bed and banks are extremely hot and dry. The perennial pioneers must therefore be able to survive extreme, if temporary, conditions of drought and heat. At the same time, these pioneers must be well rooted and mechanically as well as physiologically capable of withstanding strong water-flow and submersion during inundation. This type of hydrosere is transitional to the following class, i.e. the "hydrolithosere". This sere can be seen along the granite-gneiss bedrock forming the banks and bed of the Ramadiepa River in the vicinity of the rapids and falls, downstream of the Merensky Dam (see Plate 9).

Rooted in crevices of the river-beds, upwards of the low-water level are to be found such plants as:

Floscopa glomerata	Carex aethiopica
Juncus brevistylis	Eragrostis atrovirens
Leersia hexandra	Ischaemum arcuatum
Osmunda regalis (shadier places)	Ethulia conyzoides
Conyza ulmifolia	*Paspalum urvillei
Lipocarpha senegalensis	Pennisetum natalense
Scirpus inclinatus	Phragmites communis
Xyris capensis var.	Pulicaria scabra
X. rehmannii	Pycreus polystachyos
Agrostis lachnantha	Schizachyrium semiberbe

Together with such grasses as Agrostis lachnantha and Ischaemum arcuatum, the creeping fern Thelypteris palustris var. squamigera colonises the lower parts of seepages over the bare rock (i.e. transitional to the "hydrolithosere", see below). Seedlings of the trees Syzygium cordatum and Adina microcephala var. galpinii colonise rock crevices often a considerable distance from the water's edge (see Plate 10). The further course of succession is uncertain but, if undisturbed, it is possible that a narrow strip of gallery forest dominated by Adina microcephala var. galpinii and Syzygium cordatum (cf. p. 96-102) could eventually develop from the waterside vegetation in particular.

2. "HYDROLITHOSERES"

In the absence of any term appropriate to this distinctive sere, the term "hydrolithosere" has been coined to refer to situations where succession is initiated on rock surfaces over which water trickles permanently or semipermanently, and which may or may not be subject to periodic desiccation. Several variants of this type of succession may be distinguished. Although the initial stages are similar, the later successional stages tend to converge on later stages of the

Plate 10. Rocky bank of Ramadiepa River. *Adina microcephala* var. *galpinii* colonising rock crevices in foreground, with *Ischaemum arcuatum*, *Pterocarpus angolensis* in background (lithosere).

hydrosere on the one hand and of the lithosere on the other.

The descriptions given below are based on observations made during 1961-62. In view of the extreme conditions obtaining from time to time and the variable effect of wet and dry years, the vegetation under these unstable conditions varies enormously in coverage and species composition.

(A) SUCCESSION COMMENCING ON PERMANENT WATER RUNNING AND TRICKLING OVER SLIGHTLY SLOPING SOLID ROCK

(1) Initial Stage. The sere is initiated by Schizophyta, especially *Nostoc* sp. (probably *N. sphaericum*), filamentous and other algae. *Nostoc* sp. forms conspicuous, rounded brownish green gelatinous masses in which seeds of higher plants, e.g. *Laurembergia repens* and *Andropogon eucomus*, may germinate. The mats formed by *Nostoc* sp., filamentous and other algae, *Utricularia livida* and *Laurembergia repens*, and the moist accumulations of transported soil and gravel are colonised by several common species. After this stage, the seres diverge as the conditions remain moist or become progressively drier.

Where the habitat remains moist, among the most common pioneers are *Nostoc* sp., *Utricularia livida*, *Laurembergia repens*, *Xyris capensis* var. *medullosa*, *Andropogon eucomus*, *Eragrostis gummiflua* (drier edges), *Ischaemum arcuatum*, *Lipocarpha senegalensis* and *Rhynchospora glauca*.

(2) *Ischaemum arcuatum* Consocies. In the moister parts, the above pioneers yield to an *Ischaemum arcuatum* Consocies in which the dominant may be accompanied, to a greater or lesser extent, by such species as *Conyza ivaefolia*, *C. ulmifolia*, *Ethulia conyzoides*, *Pycreus polystachyos*, *Rhynchospora glauca*, *Stephania abyssinica* and *Thelypteris palustris* var. *squamigera*.

(3) Hydrolithoseral Scrub. It would appear that there is an increase of the shrubby *Conyza ivaefolia* in the *Ischaemum arcuatum* Consocies. Other shrubby species such as *Helichrysum splendidum* and occasional *Cliffortia nitidula* var. *pilosa* also enter the sere at this stage, together with the lianoid *Smilax kraussiana* and several trees, notably *Syzygium cordatum*, with *Adina microcephala* var. *galpinii* in crevices in bare solid rock. *Bridelia micrantha* occurs together with occasional *Acacia ataxacantha*, *Anthocleista grandiflora*, *Combretum erythrophyllum*, *Ficus capensis*, *Halleria lucida* and *Maesa lanceolata*, where there is not an excess of water. Where there is an excess of swiftly running water, it appears likely that this open scrubby

community will close up to form a Syzygium cordatum Consocies or Post-climax (see Secondary Syzygium cordatum Consocies, p. 75-7). Where there is not an excess of water, this community is likely to close up to give rise to the following stage:

(4) Hydrolithoseral Scrub Forest. This is a more or less closed-canopy community. It is dominated by Syzygium cordatum accompanied by Bridelia micrantha, Ficus capensis and Maesa lanceolata with occasional Acacia ataxacantha, Anthocleista grandiflora, Antidesma venosum, Halleria lucida and other trees. These trees form a dark community with exposed roots sprawling over the rocks, over and between which water may run. Associated species are the climbing Cissampelos torulosa, Smilax kraussiana and Stephania abyssinica, an occasional shrubby Flemingia grahamiana, the herbaceous Ischaemum arcuatum, Pennisetum natalense, Panicum hymeniochilum var. glandulosum and Hyparrhenia cymbaria, with occasional Cyperus distans, Floscopa glomerata and Polygonum strigosum among others, including the ferns Thelypteris bergiana and T. palustris var. squamigera.

In fairly open parts with a fair accumulation of soil and gravel, may be found some Syzygium cordatum and Ficus capensis with Halleria lucida and Maesa lanceolata, together with Rhynchospora glauca and Ischaemum arcuatum. Additional plants occurring include several mosses, Andropogon eucomus, Cymbopogon validus, Eulophia angolensis, Hyparrhenia hirta, Monocymbium ceresiiforme, Endostemon obtusifolius, Flemingia grahamiana, Hermannia gerrardii, Mohria caffrorum, Pelargonium luridum, Pellaea viridis and Thelypteris palustris var. squamigera. Canthium huillense plays an important part in the thickening up of the more open parts.

The more closed, as well as the more open parts, appear to be developmental stages. The course of their development is apparently towards a type of gallery forest. Owing to the paucity of the soil, however, the seres have been arrested at the present stages. The more or less closed woodland of Syzygium cordatum has apparently developed direct from numerous seedlings rooted in crevices in the bedrock and between the surface rocks. The more open parts, on the other hand, appear to have developed with the accumulation of soil from originally predominantly herbaceous stages. The more open parts with more soil will evidently thicken up into a type of gallery forest in the foreseeable future. The more or less closed Syzygium cordatum community with scanty soil will apparently persist in its present form for many years to come, with only gradual development towards a more complex gallery forest community with gradual building up of the soil.

Plate 11. Early stages of hydrolithosere (B), western bank, Ramadiepa River, Gelukauf. Beyond initial stage in foreground is stage of enlarging tufts of *Rhynchospora glauca*, with increase and spread of *Syzygium cordatum*, *Thelypteris palustris* var. *squamigera*, *Andropogon eucomus*, *Conyza* spp., etc.

To revert to the initial stages of this sere, the drier parts of the initial stage (1) are colonised by Mariscus aristatus with Exacum quinquenervium. Antherotoma naudinii may enter at this stage on bare rock or in the light shade of pioneer grasses, like Andropogon eucomus and Eragrostis gummiflua, or later-stage grasses, e.g. Cymbopogon validus, Hyparrhenia dissoluta and Loudetia simplex. Later-stage colonists are Microchloa caffra, Sporobolus stapfianus, Pellaea viridis, Aeolanthus rehmannii, Hyparrhenia dissoluta, Loudetia simplex, occasional Chlorophytum bowkeri and other pioneers of the rock mat formation of the lithosere (see p. 77 et seq.), on which this sere converges. *Bidens pilosa and other annual weeds may enter the sere at this stage.

(B) SUCCESSION COMMENCING ON SEMIPERMANENT WATER TRICKLING OVER MORE STEEPLY SLOPING SOLID ROCK

This sere is also found on the banks of the Ramadiepa River, being best developed on the western banks, where the water is derived by seepage and leakage from the Gelukauf canal (see Plate 11).

(1) Early Stages. Where a shallow layer of water trickles over rocks, a thin layer of various algae soon develops in which a variety of spores and seeds may germinate and become established. The small plants may occur in colonies of one species, as is often the case with Syzygium cordatum, which may continue to grow for a long time without being rooted in a stable substratum. A stunted unbranched seedling less than six inches tall has even been observed to bear flowers. The more common plants colonising these wet surfaces of the steeper rocky banks, more or less in order of their establishment (or abundance in the earliest stages), are the following:

Drosera dielsiana
Utricularia livida
Antherotoma naudinii
Laurembergia repens
Xyris capensis var.
X. rehmannii
Eriocaulon sonderianum
Lipocarpha senegalensis
Pycreus polystachyos
Rhynchospora glauca
Andropogon eucomus
Digitaria debilis
Eriochrysis pallida
Conyza ulmifolia
C. ivaefolia
Syzygium cordatum

Thelypteris palustris var. squamigera and even isolated T. totta may be rooted in crevices with rootstocks trailing over the wet rock surface.

As Rhynchospora glauca tufts enlarge, more and more Syzygium cordatum seedlings become established. At the same time, Thelypteris palustris var. squamigera, Andropogon eucomus, Eriochrysis pallida, Loudetia simplex, Conyza ulmifolia and C. ivaefolia tend to spread. Contemporaneously, a tropical mesophytic form of Bulbostylis boeckeleriana, Fimbristylis dichotoma, Paspalum commersonii, Crassocephalum picridifolium, Dissotis canescens, Helichrysum sp., cf. H. odoratissimum, Phaulopsis imbricata, Maesa lanceolata, Halleria lucida, Ficus capensis and Bridelia micrantha become established. These changes are tending in the direction of the secondary Syzygium cordatum Consocies (see p. 75-7).

Owing to the western exposure, less constant water and being confined to a limited area, the hydrolithosere is less well developed on the eastern bank of the Ramadiepa River. Thelypteris palustris var. squamigera colonises the lower parts of seepages over the bare bedrock, together with Agrostis lachnantha, Floscopa glomerata, Ischaemum arcuatum, Dissotis canescens and Rhynchospora glauca.

On the less steep and more broken parts of the eastern bank, the permanently wet rock surfaces below the seepage area mentioned immediately above (see also p. 74) are colonised by Commelina diffusa (especially disturbed parts), Cyperus haspan, Eriocaulon sonderianum, Hypericum lalandii, Monopsis sp., Oldenlandia goreënsis, O. lancifolia, Pycreus angulatus, P. rehmannianus, Rhynchospora glauca, Scirpus sp. (S. macer? S. setaceus?), Thelypteris palustris var. squamigera, Utricularia livida, U. prehensilis, Xyris capensis var. medullosa and X. rehmannii.

Still higher up on the more level fringe of the seepage area (below Syzygium cordatum Consocies, see p. 74), Rhynchospora glauca increases in quantity with Thelypteris palustris var. squamigera accompanied by the tropical mesophytic form of Bulbostylis boeckeleriana, Cyperus haspan and isolated Miscanthidium junceum, with Blumea lacera in disturbed parts. On somewhat drier places, the upper portions of the steep banks are lined with Ischaemum arcuatum and Trichopteryx dregeana accompanied by Helichrysum stenopterum, with occasional Ethulia conyzoides, Oldenlandia goreënsis and O. lancifolia.

Similarly on the drier, more level parts of the eastern bank, Ischaemum arcuatum is found in almost pure stands in the open, i.e. where not shaded by Syzygium cordatum (see below, p.73-5). It also occurs on the outskirts of seepage areas, where it is often accompanied by Melinis minutiflora var. inermis, Cymbopogon validus, Tephrosia shiluwanensis, Pseudarthria hookeri and others.

On the more level portions of rock kept almost permanently wet by seepage water, in the very meagre accumulations of soil and organic matter derived from Cyanophyta, algae and such angiosperm pioneers as Commelina diffusa and Ilysanthes dubia, an open herbaceous community may become established. Typical components of this community are Commelina diffusa, Leersia hexandra, Laurembergia repens, Scirpus setaceus, *Paspalum urvillei, Pycreus rehmannianus, Lipocarpha senegalensis, Juncus brevistylis, Xyris capensis var. medullosa, Ilysanthes dubia, with occasional Eriocaulon sonderianum, Paspalum commersonii, Pycreus polystachyos and Rhynchospora glauca. On such a site, succession at first proceeds slowly until sufficient soil has been built up to allow large-scale colonisation, mainly by Ischaemum arcuatum and Rhynchospora glauca. After this, succession would proceed rapidly with the greater soil accumulation permitting rapid colonisation by Syzygium cordatum, leading to the development of a S. cordatum Consocies.

(2) Syzygium cordatum Consocies. The S. cordatum woodland represents a fairly advanced stage of the succession on seepage areas, considerably advanced on the initial and transitional stages, mentioned in this section, and somewhat advanced on the more open Hydrolithoseral Scrub Forest of the previous section (see p. 70) where there is some measure of soil accumulation. The example described below is provided by the woodland dominated by S. cordatum on part of the seepage area on the eastern bank.

(2.1) Habitat. Although developed on a layer of vlei soil which may not be entirely residual and hydrolithoseral in origin, this saturated soil layer is shallow and overlies solid bedrock so that this community can perhaps justifiably be regarded as falling under the head of the "Hydrolithosere". As with the hydrolithoseral and much of the hydroseral stages discussed thus far, this seepage area may well be, to some extent, secondary.

(2.2) Structure and Composition. In structure, this community is an open to closed woodland with scattered to clumped Syzygium cordatum. Only two main strata are clearly differentiated, viz. the tree and field layers, although other synusiae are represented.

(a) Tree Layer. The tree layer is clearly dominated by Syzygium cordatum, associated with Bridelia micrantha and accompanied by occasional transgressive Adina microcephala var. galpinii, Halleria lucida and Maesa lanceolata. While the shrubby Pycnostachys reticulata is present, a true shrub layer is not developed.

(b) Field Layer (up to 1 m in height). This stratum is completely dominated by grasses and sedges, accompanied by other tufted monocotyledonous herbs. This growth form predominates in the taller sublayer. The sublayer of associated low herbs is very much subdued.

(i) Taller Herbs and Ferns. Ischaemum arcuatum is clearly dominant, associated with the following species:

Thelypteris palustris var.
Rhynchospora glauca
Trichopteryx dregeana
Cyperus haspan
Xyris rehmannii*
Leersia hexandra
Conyza ulmifolia
Helichrysum sp.,
cf. H. odoratissimum
Scirpus macer
Bulbostylis boeckeleriana forma
Pycreus mundii
Dissotis canescens
Senecio inornatus
Juncus brevistylis
Panicum aequinerve?
P. hymeniochilum var.?
*Paspalum urvillei
Pennisetum macrourum
Aristea ecklonii
Blumea lacera
Crassocephalum picridifolium
Cyperus distans
Kyllinga melanosperma
Pycreus angulatus
P. rehmannianus
Setaria sphacelata (localised, drier [parts)

(ii) Low Herbs (up to 0.25 m in height). The following plants are confined to the open patches between the large tufts of the previously listed grasses and sedges, where they are associated with Xyris rehmannii:

Eriocaulon sonderianum
Laurembergia repens
Hydrocotyle americana
Xyris capensis var.
Oldenlandia goreënsis
Utricularia livida
Alchemilla rehmannii
Floscopa glomerata
Oldenlandia lancifolia
Desmodium hirtum

Along the more sunny lower edge of the seepage areas, where the water trickles onto and over the river-bank, the lax hygrophilous form of Hypericum lalandii and Monopsis sp. may also occur with Pycreus angulatus and the species listed above (see p.72-3).

(c) Climbers. Climbing plants are poorly represented. The soft twiners Vigna sp. and Cissampelos torulosa are confined to the field-layer height class. The tendril-climber Smilax kraussiana occasionally clambers up into the tree stratum.

(2.3) Ecological Notes. Buttress roots may be fairly well developed on Syzygium cordatum. The trunks and branches of Bridelia micrantha are spiny with root-thorns, i.e. spine-tipped aerial roots, the lowermost of which, in a still, shaded, humid atmosphere, may grow

Plate 12. Secondary *Syzygium cordatum* Consocies.

downwards into the substratum to form prop roots.

Syzygium cordatum reproduces abundantly where tufts of grasses and sedges are not too dense, which suggests that a closed-canopy S. cordatum subclimax type of forest or a S. cordatum postclimax consociation will develop in due course. This evergreen community is clearly related to the swamp forests dominated by S. cordatum which are widely distributed on deeper soil in "kommetjies", swampy hollows and the more level parts of kloofs well up into the Mistbelt. It is also related to the closed-canopy secondary Syzygium cordatum Consocies found on the west bank of the Ramadiepa River and described below.

(3) Secondary Syzygium cordatum Consocies. This secondary community has developed on a steep rocky bank below the Gelukauf canal where much leakage and seepage takes place and where the rock surface is broken and more favourable for the accumulation of gravel, silt, soil and litter between the rocks. The canal has been in existence for sufficient length of time to allow this community to develop.

(3.1) Structure and Composition. The following synusiae are present:

(a) Overstory. Infrequently scattered emergent trees of Anthocleista grandiflora may be up to 12 m or more tall.

(b) Canopy. The mostly fairly open to irregularly closed canopy is mainly between 8 m and 10 m in height. Syzygium cordatum predominates (see Plate 12), associated with occasional Bridelia micrantha, Ficus capensis, Adina microcephala var. galpinii and Trema orientalis, with transgressive Anthocleista grandiflora. Scattered smaller specimens of Combretum gueinzii and Faurea saligna occur in the drier parts.

(c) Understory. Halleria lucida, 2.5 m to 5 m tall, dominates the poorly differentiated understory, associated with Antidesma venosum and Maesa lanceolata. Occasional *Psidium guajava trees reach about 4 m in height, usually accompanied by numerous saplings. Heteropyxis natalensis also occurs as an isolated understory tree especially in the drier spots.

(d) Shrub Layer. This height class consists largely of transgressives, predominantly Syzygium cordatum with Halleria lucida and occasional other canopy and understory constituents. True shrubs are only poorly represented. Occasional *Vernonia ampla* and isolated *Conyza ivaefolia* and *Dissotis canescens* may reach shrub dimensions.

(e) Field Layer. This stratum is most conveniently regarded as consisting of two sublayers differing in height and degree of woodiness.

(i) Undershrubs and Tall Subwoody Herbs. This subclass is poorly developed. The most abundant species is *Phaulopsis imbricata*, associated with *Conyza ivaefolia*, together with small *Dissotis canescens* and *Conyza ulmifolia*, *Crassocephalum picridifolium*, occasional *Conyza hochstetteri*, *Helichrysum* sp., cf. *H. odoratissimum*, and *Senecio pterophorus*, with isolated *Epilobium salignum*, *Helichrysum stenopterum*, *Rhoicissus tridentata* and small *Vernonia ampla*.

(ii) Low or Soft Herbs and Ferns. This sublayer is well developed but very patchy in composition, varying as the substratum varies from rock to soil pocket, saturated to drier and shaded to sunny spots. Grasses, sedges and ferns predominate. Among the more abundant species are the following:

Thelypteris palustris var. 2	*Thelypteris bergiana* 1
Rhynchospora glauca	*Trichopteryx dregeana*
Ischaemum arcuatum	*Cymbopogon validus* 1
Thelypteris totta 2	*Kyllinga melanosperma* 2
**Paspalum commersonii* 1	*Laurembergia repens* 2
Osmunda regalis 2	*Leersia hexandra*
Carex spicato-paniculata	*Lycopodium cernuum*
Paspalum urvillei 1	*Lysimachia ruhmeriana*
Imperata cylindrica 1	*Oplismenus hirtellus*
Panicum aequinerve? 2	*Pellaea viridis* 1
Pycreus mundii 2	*Pteris vittata*
Andropogon eucomus	*Rhynchelytrum repens* 1
Aristea ecklonii 1	*Scirpus setaceus* 2
Cyperus sp.	*Setaria sphacelata* 1
Floscopa glomerata 2	*Xyris capensis* var. 2
Oldenlandia goreënsis	*X. rehmannii* 2
**Paspalum dilatatum* 1	*Loudetia simplex* 1 (rare)
Scirpus macer 2	*Sporobolus pyramidalis* 1 (rare)

(f) Ground Layer. A ground layer is scarcely developed. Mosses and liverworts, viz. species of *Marchantia* and *Anthoceros*, do occur locally on wet rocks but the usually considerable depth of litter prevents their spread.

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1 Especially on drier sites

2 Especially on wetter sites.

(g) Lianoid Plants. Climbers occur only infrequently and seldom reach the canopy. The commonest climber is *Smilax kraussiana*. Next in order is the scrambler *Bauhinia galpinii*. Also present are the slender twiners *Abrus fruticulosus* and *Cissampelos torulosa*, together with the more robust *Acacia ataxacantha*, *Adenia gummifera*, *Dalbergia armata*, **Passiflora edulis* and *Rubus pinnatus*, and the slender *Stephania abyssinica*.

(h) Hemi-Epiphytic Stranglers. The only strangling fig observed in this community is the isolated *Ficus petersii*. Being independent of the peculiar edaphic circumstances, it cannot be regarded as characteristic of the community any more than any other epiphyte.

(3.2) Ecological Notes. In view of the mainly rather open nature of the canopy and because the trees have apparently not yet reached their maximum height, this community can be regarded as a consocies rather than as a consociation. It will presumably undergo a change in facies as the trees grow and the canopy increases in height. It would appear that the increase of *Adina microcephala* var. *galpinii* and *Anthocleista grandiflora*, as well as of *Antidesma venosum*, *Bridelia micrantha*, *Ficus capensis*, *Halleria lucida* and *Maesa lanceolata* will eventually result in a type of forest similar to the gallery forest of rocky river banks (see p. 96 *et seq*.). The herbaceous and ground floras will, however, probably remain specialised, adapted to the peculiar conditions imposed by the substratum.

3. XEROSERES

3.1 RIVER-VALLEY VARIANTS OF XEROSERES:

LITHOSERES

The only primary bare areas of the xerosere are outcrops of granite-gneiss bedrock at places along the banks of the Ramadiepa River, down-stream of the Merensky Dam. The lithoseres developed can be discussed under two heads according to whether the primary rock surface crops out as more or less unbroken sheets or whether it is much seamed, jointed or broken.

(A) ROCK-MAT FORMATION

The succession on bare sheets of unbroken granite-gneiss bedrock

Plate 13. Pioneer stages of rock mat formation, Gelukauf. In foreground: Selaginella dregei followed by Sporobolus stapfianus, Microchloa caffra, Pellaea viridis and Hyparrhenia dissoluta.

leads to the formation of a thin layer of initially gravelly to sandy siliceous soil carrying an often surprisingly dense mat of characteristic pioneer and later-stage plants. The only area where this habitat has been observed in this zone is on the western bank of the Ramadiepa River (see Plate 13). Although fragmentary stages may be seen elsewhere, the rock mat formation is best seen on slightly sloping bedrock above the Gelukauf canal.

(1) Early Stages. Except in occasional crevices, the first pioneers are cryptogamic. Crustose lichens are normally very scarce here, probably owing to the extreme conditions of heat and drought that often prevail for long periods. The sere is initiated largely by hardy mosses and *Selaginella dregei* which form mats (especially *S. dregei*), at first particularly in crevices and slight depressions but spreading thence over the rock surface. As a result of this colonisation of bare rock, accumulations of organic material, sandy and gritty siliceous and dust particles are built up and stabilised. These accumulations are soon colonised by occasional *Cyperus rupestris*, *Microchloa caffra*, *Pellaea viridis*, *Sporobolus stapfianus*, *Tripogon abyssinicus*, *Aeolanthus rehmannii*, *Commelina africana* and *Kalanchoe rotundifolia*, with *Vellozia villosa* and occasional *Eragrostis gummiflua*. *E. gummiflua* is more frequently found at the edges of the rock mat. *Stereochlaena cameronii* and *Loudetia simplex* occur especially in deeper accumulations. Any one of the above plants may, however, initiate the succession in small accumulations of vegetable matter and siliceous sandy soil in depressions and crevices in the solid rock.

(2) Later Stages. The areas colonised by the above pioneers are quickly invaded by less hardy grasses, weeds and other herbs and sub-woody plants. Of these the following are among the most important:

Rhynchelytrum repens
Hyparrhenia dissoluta (see Plate13)
H. hirta
H. filipendula
Dipcadi viride forma (Scheepers 1053)
Chlorophytum bowkeri
Hibiscus meeusei
H. cannabinus
Sida rhombifolia
S. cordifolia
Commelina diffusa
Eragrostis curvula
Heteropogon contortus
Triumfetta rhomboidea
T. pilosa var. *tomentosa*
Waltheria indica
Cassia mimosoides
Stylosanthes mucronata
**Bidens pilosa*
**Tagetes minuta*

The soft creepers and twiners *Ipomoea plebeia* subsp. *africana* and *Ceropegia setifera*, the shrubby *Cassia occidentalis*, *Lippia javanica*, *Pycnostachys urticifolia* and *Vernonia ampla*, and the small woody

Lannea edulis accompany the above species. These pioneers are soon joined by occasional *Cymbopogon validus*, *Hyparrhenia gazensis*, *Gerbera jamesonii* and *Smilax kraussiana*. The prostrate *Rhynchosia monophylla* may become established and spread its trailing stems over the bare rock, thus also preparing a niche in which other plants can become established. The subshrubby *Alysicarpus rugosus* and *Eriosema psoraleoides* and the more shrubby *Rhynchosia komatiensis* and *Pseudarthria hookeri* can enter at this stage, accompanied or soon followed by the scramblers *Acacia ataxacantha* and *Bauhinia galpinii*, together with the liane *Adenia gummifera*.

Antidesma venosum, *Heteropyxis natalensis*, *Maesa lanceolata*, *Rhus transvaalensis*, *Ziziphus mucronata*, *Dichrostachys cinerea* subsp. *nyassana*, *Lannea discolor* and *Strychnos spinosa* are prominent among the small trees which become established at this stage in the rock mat. Potentially larger trees that may also enter the sere at this stage include *Parinari curatellifolia* subsp. *mobola*, *Combretum gueinzii*, *Faurea saligna*, *Combretum suluense*, *Peltophorum africanum*, *Pterocarpus rotundifolius*, *Terminalia sericea* and *Pterocarpus angolensis*, with occasional *Erythrina lysistemon* and *Syzygium cordatum* (especially near seepage areas). It can be noted that small trees such as *Vangueria infausta*, *Lannea discolor*, *Dichrostachys cinerea* subsp. *nyassana* and *Strychnos spinosa*, and even larger trees, e.g. *Parinari curatellifolia* subsp. *mobola*, may become established in rock crevices at an early stage. As the trees increase in number and size, an open woodland develops which thickens up to form a closed-canopy community like that described below.

(3) *Combretum-Faurea-Parinari Species Associes*. This community adjoins the preceding stages of the rock mat formation on the western bank of the Ramadiepa River above the Gelukauf canal. It is found on a shallow layer of siliceous to somewhat laterised reddish sandy loam over granite-gneiss bedrock.

(3.1) *Structure and Composition*. The canopy is more or less closed but irregular in height with scattered grassy open spaces. Although the community is not conspicuously stratified, the following synusiae can be distinguished:

(a) *Canopy*. The canopy is closed for the most part, varying between 5 m and 10 m in height. The dominant trees are *Combretum gueinzii*, *Faurea saligna* and *Parinari curatellifolia* subsp. *mobola*. Next in order are *Antidesma venosum*, *Bridelia micrantha*, Combretum zuluense, Pterocarpus angolensis, P. rotundifolius, *Psidium guajava, Peltophorum africanum, Ziziphus mucronata and Strychnos spinosa, with occasional Ficus capensis, Syzygium cordatum and Terminalia sericea. Although Acacia ataxacantha frequently reaches the canopy, it is normally dependent upon other trees for support.

(b) Understory. Although several small trees 2 m to 5 m tall occur, they do not form a distinct layer while transgressives of all sizes obscure the picture. The more numerous species in this stratum are Dichrostachys cinerea subsp. nyassana, Acacia davyi, Annona senegalensis, Cassia petersiana, Maytenus heterophylla, Pavetta eylesii, Rhus transvaalensis and Vangueria infausta together with unusually large specimens of Vernonia ampla. Many small trees of *Psidium guajava, Halleria lucida and Euclea crispa also occur, of which very few will ever reach the canopy.

(c) Shrub Layer. A well-defined shrub stratum is absent. The more abundant shrubby plants that do occur include Pseudarthria hookeri, Rhynchosia komatiensis, Vernonia shirensis, Pycnostachys urticifolia and Vernonia ampla. Lippia javanica and Diospyros lycioides subsp. sericea very seldom reach shrub size here. Similarly, the lianoid shrubby Rhoicissus tridentata and Cryptolepis oblongifolia, with twining shoots, are often mechanically independent but seldom reach shrub size.

(d) Field Layer. The field layer includes plants up to about 2 m tall. Plants more than 1 m tall are distinguished from shrubs on the basis of their predominantly herbaceous habit. This distinction is sometimes difficult to apply and is then somewhat arbitrary. Two sublayers can conveniently be recognised, as set out below:

(i) Tall Subwoody Forbs and Undershrubs. This subclass is poorly represented and consists of subwoody mostly suffrutescent plants, usually exceeding 1 m in height. The more abundant species are Asparagus virgatus, *Capsicum frutescens, Justicia cheiranthifolia, Ocimum urticifolium, Sida rhombifolia, S. cordifolia, Acalypha petiolaris, Athrixia phylicoides, Desmodium barbatum var. dimorphum, Triumfetta pilosa var. tomentosa and T. rhomboidea.

(ii) Low Soft Herbs and Ferns. Most of the plants in this sublayer are less than 1 m tall although sometimes subwoody. Where they exceed 1 m in height, as in the case of certain grasses, their habit is clearly herbaceous. The field layer is dominated by grasses of which the most abundant species are _Setaria sphacelata_ and _Oplismenus hirtellus_ associated with _Hyparrhenia gazensis_ and accompanied by the following species:

Loudetia simplex	_Gerbera jamesonii_
Panicum maximum	_Hyparrhenia hirta_
Andropogon schirensis var.	_Rottboellia exaltata_
Pavonia columella	_Achyranthes aspera_
Setaria chevalieri	_Brachiaria brizantha_
Sporobolus pyramidalis	_Crotalaria mucronata_
Cymbopogon validus	_Gerbera glandulosa_
Pellaea viridis	_Paspalum commersonii_
Aloe lettyae	_Sporobolus fimbriatus_ var.

Isolated specimens of the woody _Lannea edulis_ also occur as relics of succession and may sometimes reach a height of 0.75 m.

(e) _Lianoid Plants._ Lianes and scramblers contribute to the canopy only infrequently. The more numerous lianoid canopy components are the scramblers _Acacia ataxacantha_ and _Bauhinia galpinii_, with _Smilax kraussiana_, occasional _Adenia gummifera_, *_Passiflora edulis_, _Senecio deltoideus_ and _Sphedamnocarpus galphimiifolius_. _Secamone parvifolia_ is also present as a rather rare Lowveld Sour Bushveld element.

Lianoid plants not reaching the canopy are also rather infrequent. The more abundant species are _Cissampelos torulosa_ and _Smilax kraussiana_, with _Abrus fruticulosus_ and occasional _Asparagus plumosus_, _Cryptolepis oblongifolia_ and *_Passiflora edulis_.

(f) _Epiphytes._ The only vascular epiphyte observed in this community was a small specimen of the orchid _Ansellia gigantea_ var. _gigantea_.

(3.2) _Ecological Notes._ Potential canopy trees are abundantly represented in places, especially _Parinari curatellifolia_ subsp. _mobola_. The other more numerous transgressives include _Euclea crispa_, *_Psidium guajava_, _Acacia ataxacantha_, _Bridelia micrantha_, _Faurea saligna_, _Combretum gueinzii_, _Antidesma venosum_, _Halleria lucida_, _Heteropyxis natalensis_ and _Ziziphus mucronata_, with isolated _Pterocarpus angolensis_ and _Syzygium cordatum_. Although _P. curatellifolia_ subsp. _mobola_ is reproducing abundantly, it seems unlikely that this will lead to the development of a _P. curatellifolia_ subsp. _mobola_ Consocies.

This _Combretum-Faurea-Parinari_ species Associes can be regarded as a preclimax savanna woodland more or less subclimax to climax savanna woodland (see p. 88-92) but indefinitely arrested at this stage owing to the shallowness of the soil and the slowness of soil formation on the solid rock. A few termitaria, including a large one, were observed but, in view of the shallowness of the soil, it seems unlikely that these could effectively ameliorate soil moisture conditions to enable a more mesophytic community to develop in the foreseeable future.

(B) LITHOSERE ON SEAMED TO BROKEN ROCK

A primary bare area of seamed, jointed and variously broken granite-gneiss bedrock is met with on the Gelukauf bank of the Ramadiepa River, downstream of the bridge on the main Duiwelskloof-Tzaneen road (see background, Plate 10, p. 69).

This sere proceeds more rapidly than that on unbroken rock sheets, owing to the presence of many crevices, depressions and soil pockets favourable for colonisation. Because of the variety of niches supporting various successional stages, there is no clear zonation of stages. Nevertheless, certain general tendencies can be traced.

(1) Early Stages. The sere is initiated on the bare rock by a few crustose lichens, probably mostly species of *Buellia* and *Caloplaca*, and hardy mosses, e.g. *Ptychomitrium eurybasis*. These are followed by *Selaginella dregei* and occasional *Pellaea viridis*, *Aeolanthus rehmannii*, *Ficus ingens*, *Kalanchoe rotundifolia*, *Loudetia simplex*, *Microchloa caffra*, *Sporobolus stapfianus*, *Commelina* sp. (*C. africana*?), *Eragrostis curvula*, *Panicum maximum*, *Rhynchelytrum repens*, *Cyperus albostriatus*, *Hyparrhenia* sp. (*H. filipendula*? *H. hirta*?) and *Fadogia monticola*. In addition to these pioneers, such short-lived weeds as *Achyranthes aspera*, *Cleome monophylla*, *Triumfetta pilosa* var. *tomentosa* and *T. rhomboidea* also occur.

(2) Later Stages. The foregoing are soon joined by *Carex spicato-paniculata*, *Digitaria milanjiana* and *Setaria chevalieri*, especially in more or less shaded situations. The undershrubs *Justicia cheiranthifolia*, *Endostemon obtusifolius*, *Hibiscus altissimus* and *Phaulopsis imbricata* may enter the sere at this stage together with the small woody *Lannea edulis*. These subwoody plants are joined by the following larger woody shrubs and trees:

Vangueria infausta
Antidesma venosum
Dichrostachys cinerea subsp.
Parinari curatellifolia subsp.
Ficus ingens
Heteropyxis natalensis
Acacia ataxacantha
Annona senegalensis
Bridelia micrantha
Combretum gueinzii
Dombeya rotundifolia
Euclea crispa
Ficus petersii
Osyridicarpos schimperianus *
Pittosporum viridiflorum
Pterocarpus angolensis
P. rotundifolius
Strychnos spinosa

The above species are accompanied or soon followed by the lianoid plants Bauhinia galpinii, Cryptolepis oblongifolia, Rhoicissus tridentata and Smilax kraussiana, and also the leafless succulent Sarcostemma viminale and hemiparasitic Cassytha ciliolata.

This colonisation of soil pockets leads, with the growth of trees, to the relatively rapid amelioration of the habitat as a whole through shading against extremes of temperature and evapotranspiration, and the widespread and large-scale deposition of litter. As a result, vegetation spreads relatively rapidly outwards from the soil pockets, eventually to form a continuous herbaceous cover with scattered trees and shrubs. In this way, a type of savanna, exemplified by the following community, may develop.

(3) Parinari-Bridelia-Pterocarpus Species Associes. This community clearly represents only a transient stage in the development of a closed-canopy community from the stages just mentioned. An example of this stage is found as a strip extending for a short distance below the Waterval canal between the main Duiwelskloof-Tzaneen road and the eastern banks of the Ramadiepa River.

(3.1) Structure and Composition. As constituted at present, this community occurs as an open savanna with closed canopies developing in a few spots. The following synusiae can be distinguished:

(a) Tree Layer. The trees are irregularly distributed and vary in height from 2 m to 12 m. The most abundant trees are mainly as yet young Parinari curatellifolia subsp. mobola (7 m) associated with Bridelia micrantha (8 m), Pterocarpus angolensis (10 m) and P. rotundifolius (10 m). They are accompanied by Acacia ataxacantha (10 m), Combretum gueinzii (6 m - 7 m), Faurea saligna (10 m), *Psidium guajava and large Vernonia ampla, together with occasional Antidesma venosum, Dichrostachys cinerea subsp. nyassana, Halleria lucida,

* Hemiparasitic on roots.

Heteropyxis natalensis, Maesa lanceolata, Maytenus mossambicensis var. mossambicensis, Rhus transvaalensis (2 m), Strychnos spinosa (7 m), Trema orientalis (12 m) and Vangueria infausta (2 m).

Isolated specimens of certain trees are worthy of note, for instance Nuxia floribunda, which is normally a Mistbelt, kloof-forest or gallery-forest tree. Syzygium cordatum is found especially in the vicinity of seepage areas (cf. p. 74-5). Catha edulis is occasionally locally gregarious on disturbed sites while Pittosporum viridiflorum becomes locally fairly frequent near the canal.

(b) Shrub Layer. Besides shrubs proper, some woody undershrubs between 1 m and 2 m tall have been included under this head. The distinction between this height class and the field layer is necessarily somewhat arbitrary. No distinction based on a single criterion could be drawn although more weight was attached to woodiness. The most abundant species in this stratum is Vernonia ampla. Associated with it are Pycnostachys urticifolia, Endostemon obtusifolius, Lippia javanica, Heteromorpha trifoliata, Rhynchosia komatiensis, Pseudarthria hookeri and Flemingia grahamiana, accompanied by occasional Canthium huillense, Diospyros lycioides subsp. sericea and Vernonia shirensis.

(c) Field Layer. The field layer includes all more or less herbaceous plants up to 2 m tall, as well as some subwoody plants normally less than 1 m tall. It can conveniently be regarded as comprising two sublayers, distinguished on the basis of size, woodiness or habit. The upper sublayer, especially, is rather weedy but there is relatively little other evidence of disturbance.

(i) Low Soft Undershrubs and Larger Subwoody Forbs. This subclass is rather poorly developed on the whole. The most abundant species is Sida rhombifolia associated with Helichrysum panduratum and accompanied by Triumfetta rhomboidea, together with Asparagus virgatus, Phaulopsis imbricata and Athrixia phylicoides, with occasional Aspilia africana, Justicia cheiranthifolia and *Capsicum frutescens.

(ii) Low Soft Herbs and Ferns. This sublayer is well developed, the grasses and sedges being particularly well represented. Loudetia simplex predominates. It is accompanied by the following plants:

Paspalum commersonii
Pellaea viridis
Cymbopogon validus
Carex spicato-paniculata
Hyparrhenia gazensis
H. hirta
Imperata cylindrica
Panicum maximum
Rhynchelytrum repens
Andropogon schirensis var.
Gerbera jamesonii
Setaria sphacelata
Tristachya hispida
Eragrostis curvula
Gerbera glandulosa
Pteridium aquilinum
Sporobolus pyramidalis
Themeda triandra
Trachypogon spicatus
Cryptolepis oblongifolia
Pelargonium luridum
Schizachyrium semiberbe
Achyranthes aspera
Becium knyanum

Cyperus albostriatus
Fimbristylis dichotoma
Glycine javanica
Mariscus sieberianus
*Paspalum urvillei
Pavonia columella
Phyllanthus burchellii
*Richardia brasiliensis
Vernonia natalensis
Acalypha punctata
*Ageratum conyzoides
Aloe lettyae
Bothriochloa glabra
Cassia mimosoides
Crassocephalum crepidioides
Cynodon dactylon
Eleusine africana
Gladiolus sp. (Scheepers 222)
Helichrysum nudifolium var.
Hypoxis angustifolia
Microchloa caffra
Oplismenus hirtellus
Pentanisia angustifolia
Thelypteris bergiana

Some of the above species are more localised. Cynodon dactylon and Eleusine africana are found on the more disturbed sites. Microchloa caffra occurs in rock crevices and on the edges of rock mats. Oplismenus hirtellus and Thelypteris bergiana are restricted to shadier places under a closing canopy. In addition, isolated clumps of Chlorophytum bowkeri may occur in shaded, broken rocky places, while Helichrysum appendiculatum is confined to the shallow peripheral sandy soil of the small rock mats. Also present are Heteropogon contortus, Ischaemum arcuatum (in seepage areas), Laggera alata, Melinis multiflora var. inermis (bordering seepage areas), Mohria caffrorum, Pellaea calomelanos (in broken rocky places) and Senecio pterophorus (especially on the more disturbed sites.)

(d) Lianoid Plants. The most common robust climber is Smilax kraussiana. Associated with it is *Passiflora edulis, accompanied by the thorny scramblers Rubus pinnatus and, sometimes, Acacia ataxacantha although the latter is usually more or less mechanically independent at this stage. Less numerous is Adenia gummifera with occasional Bauhinia galpinii, Clematis oweniae and Rhynchosia albiflora.

Softer slender climbers and twiners are only poorly represented. The most numerous species is Cissampelos torulosa. It is accompanied by Abrus fruticulosus, Asparagus plumosus, Mucuna coriacea, Stephania abyssinica and occasional Rumex sagittatus. Cryptolepis oblongifolia may also develop a lianoid habit on occasion.

(3.2) Ecological Notes. The most abundant transgressive trees are the following:

Parinari curatellifolia subsp.	*Pterocarpus rotundifolius*
Bridelia micrantha	*Trema orientalis*
Euclea crispa	*Ziziphus mucronata*
Combretum gueinzii	*Antidesma venosum*
Halleria lucida	*Dichrostachys cinerea* subsp.
**Psidium guajava*	*Ficus capensis*
Syzygium cordatum	*Maesa lanceolata*
Acacia ataxacantha	*Maytenus* sp. (*M. mossambicensis* var.?)
Heteropyxis natalensis	*Ochna holstii*?
**Jacaranda mimosifolia*	*Pterocarpus angolensis*
Peltophorum africanum	*Vangueria infausta*

By a process of thickening up with attendant improvement in edaphic conditions, this community is presumably potentially capable of giving rise to a subclimax community approaching the *Pterocarpus*-*Faurea*-*Parinari* species Association (see p.88-92) in structure and in species composition. Succession is likely to be arrested at this subclimax stage, however, owing to the shallowness of the soil.

3.2 RIDGE VARIANTS OF XEROSERES:

The communities discussed thus far are all found in river-valleys because it is practically only in the river-valleys that relics of the natural vegetation of this zone remain. Away from the valley floors, the Lowveld Sour Bushveld Transition Zone is almost fully utilised. Fragmentary relics of relatively undisturbed Transitional Lowveld Sour Bushveld savanna woodland do, however, remain along the east-southeastern boundary of Werne-Driekop (see Map, p. 3) on the mesoclinal slopes of the ridge overlooking the upper Nwanetsi River valley. Farther downslope on the farms Mieliekloof and Greystones, the Transitional Lowveld Sour Bushveld grades imperceptibly into the Lowveld Sour Bushveld.

SUBCLIMAX SAVANNA WOODLAND (RIDGE VARIANT)

Examples of the ridge variants of Transitional Lowveld Sour Bushveld can be found in the relics of savanna woodland on the Werne-Mieliekloof boundary. These remnants are too fragmentary to permit of sampling or any truly objective treatment. This should be borne in mind when reading the following generalised account.

(1) Structure and Composition. The best-preserved relics are located on broken rocky sites. In these places, the vegetation may attain a subclimax stage of development in the form of a closed-canopy

savanna woodland in which the following synusiae may be found:

(a) Canopy. A fairly closed but very irregular canopy up to 12 m in height may be developed. It is composed of such trees as Bridelia micrantha, Acacia sieberiana var. woodii, Sclerocarya birrea, Ficus sycomorus, F. burkei, F. petersii, Erythrina lysistemon, Rauvolfia caffra, Trichilia emetica, Pterocarpus rotundifolius and Combretum erythrophyllum. Lianoid and hemi-epiphytic plants also contribute appreciably to the formation of a closed canopy.

(b) Understory. A poorly defined understory, 3 m to 10 m in height, may be present in places. Apart from transgressive small trees of the above-mentioned species, Celtis africana, Cussonia spicata, Euclea crispa and Ziziphus mucronata also occur.

Peltophorum africanum and Ehretia amoena grow mainly in the open parts, but they may occasionally be found in this height class along the margins of the "bush-clumps".

(c) Shrub Layer. This stratum, 2 m to 3 m in height, consists chiefly of small trees of the above strata. Shrubs proper are infrequent and include such species as Vernonia ampla, Grewia occidentalis, Canthium inerme, Lippia javanica and Oncoba spinosa.

(d) Field Layer. Typical plants of the field stratum under a closed canopy include Carex spicato-paniculata, Oplismenus hirtellus, Setaria chevalieri, Hyparrhenia gazensis, Asparagus virgatus and Agapanthus inapertus.

(e) Lianoid Plants. Robust lianoid plants are frequent and commonly render the "bush-clumps" almost impenetrable in parts. Those that reach the canopy serve to knit it together where it would otherwise be more or less open. Among the more numerous and conspicuous lianes and scramblers are Acacia ataxacantha, Pterolobium exosum, *Caesalpinia decapetala, Bauhinia galpinii, Adenia gummifera, Rhoicissus tomentosa, Telosma africana, Helinus integrifolius, Dalbergia armata, Clematis oweniae and Carissa edulis, as well as the larger Smilax kraussiana. Although Grewia occidentalis may also occur as a scrambler it only rarely reaches the canopy.

Although fairly numerous, non-woody climbers, with the exception of Smilax kraussiana, are mostly rather inconspicuous and seldom reach the canopy. The most abundant species are S. kraussiana and Cissampelos torulosa, together with occasional Rhynchosia albiflora, Glycine javanica and Dumasia villosa.

(f) Hemi-Epiphytic Stranglers. The only representative of this synusia is *Ficus petersii* which may grow into a large tree with a spreading crown contributing substantially to the canopy or developing as an emergent.

(2) Ecological Notes. The presence of *Dumasia villosa* together with *Dalbergia armata*, *Rhoicissus tomentosa* and *Telosma africana* suggests moister conditions than would ordinarily prevail on the xeroclines or perhaps even on the tops of the ridges in the Lowveld Sour Bushveld Transition Zone. This accords well with the location of this community on the mesoclinal slopes near the summit of the ridge on the eastern edge of this climatic and vegetational zone. Here one would expect conditions to be somewhat moister than the average for this altitude (about 850 m), owing to the depression of the climatic zones on the mesoclines. Warm, moist southerly to easterly winds being forced upwards abruptly, after a virtually unobstructed passage from the Indian Ocean, may be responsible for possible additional "Massenerhebung"-like effects.

B. THE CLIMAX: PTEROCARPUS-FAUREA-PARINARI SPECIES ASSOCIATION

Having discussed the foregoing priseral communities, one may now consider what appears to be the nearest approach to the climatic climax vegetation of the Lowveld Sour Bushveld Transition Zone. This is solely represented by a small relic of closed-canopy savanna woodland or woodland (see Boughey, 1957) on the farm Waterval, at the lower end of the portion belonging to the Letaba Country Club and formerly part of Westfalia Estate. This relic lies at the top of the slope on the Waterval side of the Ramadiepa River valley and it grades into the later stages of the *Parinari-Bridelia-Pterocarpus* species Associes already discussed (see p. 83-6). Exterior views of the transitional vegetation between the latter subclimax savanna woodland and the climax association can be seen in the background of Plate 13 (p. 78).

1. HABITAT

The community described below is fairly well preserved despite some evidence of disturbance. It is an appreciable distance upslope of the Waterval canal on slightly sloping ground with probably negligible accretion of ground-water from upslope. A further point in its favour as an example of a mature "climatic" climax, is its location on a

TABLE 14. Profile description* of soil pit in river-valley variant of climax (savanna) woodland, Lowveld Sour Bushveld Transition Zone, Waterval

Horizon	Depth	Description
A_{oo}		Thin layer of litter
A_1	0-15 cm	Dusky red brown (10R 3/4) clay, massive, soft, many roots, no stones, pH 5.5
B_1	15-41 cm	Dark red (10R 3/6) clay, massive, soft, moderate roots, no stones, pH 4.8
B_2	41-230 cm	Red (10R 4/6) clay, decreasing roots, otherwise as B_1 pH 5.2 at 64 cm pH 5.5 at 102 cm

* Adapted from original tabulated description of Profile 34 by H.C. von Christen (Unpubl.).

stoneless structureless friable ferrallitic red clay which could be well described as "zonal", i.e. in equilibrium with climate and vegetation. This strongly laterised soil is locally "extremely deep and probably older than the better structured soils" (Von Christen, Unpubl.). A tabulated description of the soil profile is given in Table 14.

2. STRUCTURE AND COMPOSITION

This climax type of savanna woodland has a fairly closed canopy despite some evidence of felling. The trees are fairly uniformly spaced with the trunks usually some distance apart - a facies imparted and probably partially imposed by the codominant *Pterocarpus angolensis* with its widely spreading crown. With the exception of the canopy and the field layer, stratification is not very pronounced. The following synusiae may, however, be distinguished:

A. OVERSTORY

It would appear that isolated emergent *Anthocleista grandiflora* may exceed heights of 15 m. Infrequent emergents are *Faurea saligna* and *Parinari curatellifolia* subsp. *mobola* which reach maximum heights of about 14 m.

B. CANOPY

The dominant tree layer varies considerably in height and appearance as the component trees differ in habit. The height varies from about 6 m to occasionally slightly more than 12 m. The deciduous *Pterocarpus angolensis*, with flattened spreading crown up to 10 m or 12 m in height, and the practically evergreen *Faurea saligna*, with narrow upright crown of the same or slightly greater height, are codominant in the canopy together with *Acacia ataxacantha*. The tree-like scrambler *A. ataxacantha* can reach or even pierce the canopy when supported. *Parinari curatellifolia* subsp. *mobola* occurs frequently throughout the community and may be locally abundant. It appears to be less frequent on the seemingly more mature parts of the stand than on the apparently less mature parts and where there is evidence of disturbance. Other trees contributing towards the canopy are *Acacia karroo*, *Bridelia micrantha*, *Combretum gueinzii* and *Pterocarpus rotundifolius*. The escape **Psidium guajava* may also occasionally reach the canopy together with occasional *Syzygium cordatum*, *Trema orientalis* and *Ziziphus mucronata*.

Plate 14. Pterocarpus-Faurea-Parinari species Association: general aspect, locally dominated by Pterocarpus angolensis.

C. UNDERSTORY

A distinct understory is not developed but a height of 6 m can be arbitrarily chosen as the upper limit of the small-tree synusia. *Psidium guajava, Heteropyxis natalensis, Ziziphus mucronata, Antidesma venosum and Annona senegalensis only rarely reach the canopy but typically contribute to the formation of a subordinate small-tree or large-shrub layer. They are accompanied by occasional Rhus transvaalensis, Halleria lucida, *Jacaranda mimosifolia, Acacia davyi and Combretum suluense. The small trees Catha edulis, Dichrostachys cinerea subsp. nyassana and Strychnos spinosa are also occasionally present: usually, as with Trema orientalis, as relics of succession or where the canopy has been opened, by felling or other disturbance.

D. SHRUB LAYER

A shrub stratum between the understory and the field layer does not seem to be well developed in the apparently more mature parts of this stand. In some places, however, woody and subwoody shrubs, up to about 2 m tall, may occur fairly frequently. These include Diospyros lycioides subsp. sericea, Vernonia ampla, Canthium inerme, *Capsicum frutescens (subwoody herbaceous weed up to about 1.5 m tall), Leonotis dysophylla, Rhamnus prinoides, Pseudarthria hookeri, Lantana mearnsii, Rhoicissus tridentata and occasional Pycnostachys urticifolia.

E. FIELD LAYER

The field stratum consists of more or less herbaceous plants up to about 1 m tall. Although no clear-cut distinction can be drawn on the basis of height, this sublayer can be naturally and conveniently subdivided into two sublayers on the basis of habit, as well as of size, as follows:

(1) Low Soft Undershrubs and Taller or Subwoody Forbs. This subclass is rather poorly represented, consisting of Asparagus virgatus and the ruderal Sida rhombifolia, accompanied by Tephrosia shiluwanensis, the ruderal Triumfetta rhomboidea, occasional Acalypha petiolaris and small *Capsicum frutescens, Rhoicissus tridentata and Vernonia ampla (especially in the more disturbed places).

(2) Low Herbs and Ferns. This sublayer is fairly well developed but still does not form a continuous cover, the components tending to

be rather patchily distributed. The floor is dominated by Oplismenus hirtellus, accompanied by Pellaea viridis, Carex spicato-paniculata and Paspalum commersonii, with Gerbera glandulosa and Sporobolus pyramidalis, together with occasional Aloe lettyae, Gerbera jamesonii and *Richardia brasiliensis especially in the more open and disturbed spots.

F. LIANOID PLANTS

(1) Lianes and Scramblers. The more abundant of the more robust lianoid plants reaching the canopy are Smilax kraussiana, *Passiflora edulis, Gymnema sylvestre and Telosma africana, with occasional Acacia ataxacantha, Adenia gummifera, Bauhinia galpinii and Mikania cordata.

As in the case of Acacia ataxacantha, Combretum gueinzii occurs as a scrambler or liane as well as in the form of a tree. Mikania cordata is here much reduced in vigour in comparison with its appearance in moister habitats. Similarly, Dalbergia armata, Rhoicissus tomentosa and Sphedamnocarpus galphimiifolius may occasionally be found but they rarely, if ever, reach the canopy in this community.

(2) Softer Slender Climbers. Cissampelos torulosa is by far the most abundant soft lianoid plant. Associated slender climbers are Glycine javanica, Senecio deltoideus, Asparagus plumosus, Cyphostemma cirrhosum subsp. transvaalense and Stephania abyssinica, with occasional Abrus fruticulosus, Hewittia sublobata, Momordica foetida and Mucuna coriacea (especially in the sunnier spots). The garden escape *Aristolochia elegans may be noted in places, particularly where disturbed.

G. EPIPHYTES

Epiphytic lichens and mosses are present in small quantities. Vascular epiphytes are scarce. Pleopeltis macrocarpa is a rather rare epiphytic fern. The orchid Cyrtorchis praetermissa may be rarely encountered on rough-barked trees upwards of 2 m above the ground, but not in the hottest driest parts of the crowns as in gallery forest (see p. 100). Ansellia gigantea var. gigantea may also occur but it is rare.

3. ECOLOGICAL NOTES

Although the species of Pterocarpus and the bulk of the several tree species forming the canopy and understory are deciduous or semideciduous, the evergreen species are sufficiently abundant to lend a distinctly shady appearance to the community in the dry season. It is curious that the emergent species are more or less evergreen.

Leaf-fall commences in late autumn and continues intermittently, depending upon the species, age and situation of the tree, throughout the winter. Late winter and early spring are least shady, although early spring is marked by a flush of new foliage of some species, e.g. Bridelia micrantha, sufficient to colour the countryside.

The general impression given by at least the apparently more mature portions of the stand is one of stability. This lends support to the view that the community described above approaches the hypothetical "climatic" climax savanna woodland of the Lowveld Sour Bushveld Transition Zone.

C. POSTCLIMAXES: RIPARIAN FOREST

1. COMBRETUM ERYTHROPHYLLUM-NUXIA FLORIBUNDA-FICUS CAPENSIS ASSOCIATION

1.1 HABITAT

This community is developed on deep soil on a fairly steep, south-facing stretch of the northeastern banks of Merensky Dam. It appears to represent an advanced stage of development from the Acacia karroo Consocies (see p. 60-2) and the Combretum erythrophyllum Consocies (see p. 64-6). Unfortunately, there is ample evidence of human interference. Nevertheless, the following description probably gives some indications of the type of riparian forest to be expected on similar sites under natural conditions.

1.2 STRUCTURE AND COMPOSITION

Although the trees are very irregular in height and spacing, a more or less closed canopy is developed, varying in height from about 5 m at the upper levels of the bank to about 15 m near the water's edge. Apart from the tree, shrubby and field layers being readily recognisable, stratification is neither clear-cut nor uniform throughout but varies along a gradient from the water's edge up the bank. The following synusiae are present, however, although one or more strata may be absent in places.

(A) OVERSTORY

In view of the irregular nature of the canopy, one cannot speak of emergents in any strict sense. If the succession is allowed to progress further under protection, however, it seems likely that *Anthocleista grandiflora* and *Prunus africana* will emerge from the canopy.

(B) CANOPY

The dominant trees appear to be *Combretum erythrophyllum*, *Nuxia floribunda* and *Ficus capensis* with *Pittosporum viridiflorum* and the scrambler *Acacia ataxacantha* which contributes substantially to the canopy. Although *A. ataxacantha* does not always reach the canopy as a mechanically independent tree, it frequently forms thickets, especially higher up on the banks, in which a few individuals provide mutual support for one another. Also more or less frequent as canopy components are *Trema orientalis*, *Bridelia micrantha* and *Prunus africana*, with occasional *Acacia karroo*, *Anthocleista grandiflora*, *Erythrina lysistemon* and *Kiggelaria africana*. *Halleria lucida* and *Allophylus transvaalensis* occasionally contribute to the canopy where it is low.

(C) UNDERSTORY

This stratum (2 m to 5 m in height) is typically poorly developed in this community and the distinction between it, the canopy and the shrub layer is largely obscured by transgressive canopy trees of all sizes. Typical understory components are *Allophylus transvaalensis* and *Halleria lucida*, together with *Canthium inerme*, *Euclea crispa*, *Antidesma venosum* and *Maytenus* sp., cf. *M. heterophylla*, *Clausena anisata*, *Grewia occidentalis*, *Maesa lanceolata*, *Maytenus mossambicensis* var. *mossambicensis* and *Rhus intermedia*.

(D) SHRUB LAYER

This stratum, 1 m to 2 m in height, is also poorly developed and consists mainly of *Vernonia ampla* with *Grewia occidentalis*, *Clausena anisata* and an occasional *Diospyros lycioides* subsp. *sericea*, all these species varying greatly in size. A few of the larger *G. occidentalis* plants can rather be regarded as small trees of the understory or as mechanically dependent scramblers.

(E) FIELD LAYER

For convenience, this stratum, up to about 1 m in height, is regarded as comprising two sublayers, separated on the basis of size, life-form and degree of woodiness.

(1) Taller Subwoody Forbs and Undershrubs. The sublayer is fairly well developed. It is clearly dominated by Phaulopsis imbricata associated with Asparagus virgatus and accompanied by Schistostephium heptalobum, Stachys grandifolia, Dicliptera clinopodia, Plectranthus laxiflorus, Pavonia columella and Pteridium aquilinum (relics), with occasional Rhoicissus tridentata.

(2) Low Herbs and Ferns. This subclass is also fairly well represented. The grass Oplismenus hirtellus dominates the floor, with the fern Thelypteris bergiana subdominant, accompanied by Carex spicato-paniculata, Setaria chevalieri, Galopina circaeoides, Pteris catoptera, Cyperus albostriatus, Haemanthus magnificus, *Poa annua (disturbed sites), and Crassula thorncroftii, with occasional Mohria caffrorum.

(F) LIANOID PLANTS

With relatively few exceptions (especially Smilax kraussiana), lianoid plants fall into either of the following two more or less distinct classes:

(1) Lianes and Scramblers. The common scrambler Acacia ataxacantha has already been mentioned as a canopy component. Besides A. ataxacantha the more frequent robust lianoid plants are Dalbergia armata, Rhoicissus tomentosa, Choristylis rhamnoides, *Passiflora edulis, Secamone gerrardii, Smilax kraussiana, Clematis brachiata and Helinus integrifolius, together with occasional Adenia gummifera, Bauhinia galpinii, Gymnema sylvestre, Mikania cordata, Sphedamnocarpus galphimiifolius (subsp. ?) sens. lat. and Telosma africana.

(2) Slender Softer Climbers. Numerous less robust lianoid plants do not reach the canopy except where it is low. These include Telosma africana, Dioscorea cotinifolia, Senecio deltoideus, Cissampelos torulosa, Cyphostemma cirrhosum subsp. transvaalense, Senecio tamoides, Smilax kraussiana, and Solanum bifurcum, with occasional Adenia digitata, Dumasia villosa and Stephania abyssinica.

(G) EPIPHYTES

Cryptogamic epiphytes are inconspicuous for the most part and vascular epiphytes appear to be absent.

(H) PARASITES

The root parasite, Harveya coccinea is rather infrequently scattered in this riparian forest community. It is more frequently encountered near the margins where it may be locally fairly frequent. Sarcophyte sanguinea is very localised but rather gregarious as far as can be inferred from the distribution of the inflorescences. This species is holoparasitic on the roots of species of Acacia, and perhaps also of Trema orientalis and Ficus capensis. The rambling shrub Osyridicarpos schimperianus is hemiparasitic on roots.

1.3 ECOLOGICAL NOTES

In comparison with the previously described near-climax Pterocarpus-Faurea-Parinari species (savanna) woodland, only about half of the tree species of this Combretum erythrophyllum-Nuxia floribunda-Ficus capensis fringing forest are deciduous or semideciduous. Most of the latter are practically evergreen as the leafless period is very short. The absence of the evergreen Syzygium cordatum is difficult to account for but it seems quite likely that it will soon enter the sere.

Certain of the species already present appear to be on the increase, notably Allophylus transvaalensis, Pittosporum viridiflorum, Halleria lucida, Maesa lanceolata and Prunus africana. There is little evidence of regeneration by Combretum erythrophyllum except as a pioneer along the actual water's edge. There seems to be healthy regeneration of Ficus capensis, Euclea crispa, Trema orientalis, Bridelia micrantha, Canthium inerme and, perhaps less adequately, of Nuxia floribunda. In view of the differing rates of regeneration of different tree species and the disturbed condition of the site, it seems that this community is not yet stabilised and that succession would proceed further were the community protected from further interference. The trend appears to be in the direction of a more evergreen mesophytic community composed of such trees as Allophylus transvaalensis, Halleria lucida, Maesa lanceolata, Pittosporum viridiflorum, Prunus africana, Ficus capensis, Euclea crispa, Trema orientalis, Bridelia micrantha, Canthium inerme, Nuxia floribunda and, perhaps, Syzygium cordatum.

It may be noted that here, as in other communities, much of the

Plate 15. Edge of gallery forest, Ramadiepa River, Waterval, showing Anthocleista grandiflora and Adina microcephala var. galpinii, with Pterocarpus angolensis in foreground.

reproduction of *Ficus capensis* is vegetative. Leafy shoots may sometimes arise from the lowermost perennial compound-inflorescence axes growing from the trunk near ground level, where these are long and trail in the litter on the forest floor. These shoots may strike root and grow as more or less independent trees.

Certain physiognomic features are of interest. The peculiar compound inflorescences of *Ficus capensis* can be variously regarded as examples of "ramiflory", "idiocladanthy", "flagelliflory" or "geocarpy" and intermediate forms of cauliflory (see Richards, 1952: p. 91-2). *Halleria lucida* is also cauliflorous. Buttressing and fluting are here rather poorly developed on *Ficus capensis* and *Anthocleista grandiflora*. When rooted in a moist substratum, *A. grandiflora* also produces aerial roots from the lower part of the trunk and these may reach the soil to become prop roots (see Plate 17). The lowermost root thorns of *Bridelia micrantha* also grow downwards into the soil to form prop roots where the microclimate is sufficiently shady, damp and cool. These root thorns are characteristically scattered all over the stems and branches of this species.

2. ADINA-SYZYGIUM SPECIES ASSOCIATION

2.1 HABITAT

This gallery forest is developed along rocky river-banks and apparently culminates the rocky river-bed succession (see p. 67 *et seq*.). The following description is based on a reach of the Ramadiepa River downstream of the rapids and waterfall below Merensky Dam, mainly on the Waterval bank but including a short section of the Golukauf bank. The upstream end of this stretch of gallery forest can be seen in the left-centre background of Plate 9 (p. 67). An exterior view of the margin at the downstream end is shown in Plate 15. Along this stretch, the stream has scoured a channel a few metres below the level of the surrounding river-valley and the water runs between steep rocky banks.

2.2 STRUCTURE AND COMPOSITION

The gallery forest is mainly confined to the river-banks with the narrow margin of small trees situated on top of the bank so that the canopy of foliage forms an arching roof, reaching its highest levels over the length of the stream and curving down, almost to ground level in parts, at the margin.

Except for a few gaps, the canopy is closed. The trees are irregularly spaced but the trunks, branches and crowns are bent and elongated to fill such gaps as there may be. Stratification is not clear owing to the increase in height above the water level of the bank and the attendant reduction in height of the trees away from the water's edge. Stratification of the synusiae is thus, to some extent, obscured by zonation parallel to the watercourse. Nevertheless, the synusiae can be recognised as falling into classes determined by the actual heights of the component plants, as indicated below.

(A) OVERSTORY

Distantly spaced emergent Anthocleista grandiflora trees bear sparingly branched crowns of large leaves above the canopy to heights of 18 m and more (see Plate 16).

(B) CANOPY

The greater part of the canopy, up to about 17.5 m in height, is contributed by the two codominant species, viz. Syzygium cordatum, which occurs throughout, and Adina microcephala var. galpinii, which is restricted to the rocky banks close to the water's edge. Bridelia micrantha and Ficus capensis are associated trees of the canopy, accompanied by occasional Ilex mitis, an obligate waterside tree. Syzygium guineense is a rare canopy component in this community as are Anthocleista grandiflora and Antidesma venosum.

A feature of the gallery forest is the fringe of the more facultative and drought-tolerant species of the abovementioned trees, viz. Antidesma venosum, Bridelia micrantha, Ficus capensis and Syzygium cordatum, as well as Combretum gueinzii, Pittosporum viridiflorum and Trema orientalis. Other trees of the surrounding communities also contribute towards the forest margin such as Pterocarpus angolensis (see Plate 16), P. rotundifolius, Peltophorum africanum, Acacia karroo, Ziziphus mucronata, Parinari curatellifolia subsp. mobola and Faurea saligna.

(C) UNDERSTORY

The subordinate-tree layer is poorly developed, very discontinuous and irregular in height, the components varying from about 3 m up to about 9 m tall in places. The more common understory trees include Combretum gueinzii, Pittosporum viridiflorum, Eugenia natalitia, Canthium inerme, Ochna holstii, Maytenus heterophylla (subsp.?) sens.

lat., M. undata, Allophylus transvaalensis, Combretum erythrophyllum and Halleria lucida.

Acacia karroo and Annona senegalensis have also been noted in the understory, the latter close to the margin as a rule.

(D) SHRUB LAYER

A shrub layer is only poorly developed to almost absent. Of the more or less fully grown woody and subwoody plants from 1 m to about 2.5 m in height, the most noteworthy is Flemingia grahamiana, accompanied by Endostemon obtusifolius, Pseudarthria hookeri and Pycnostachys urticifolia, with occasional Euclea crispa (suppressed transgressive), Rhoicissus tridentata and Vernonia ampla (especially towards the edge).

(E) FIELD LAYER

This synusia, mostly less than 1 m in height, is subdivided into two subclasses on the basis of habit, particularly woodiness and life form.

(1) Undershrubs and Taller Subwoody Herbs. The lax undershrub Phaulopsis imbricata clearly predominates in this sublayer. The more frequent associated species are Asparagus virgatus, Dicliptera clinopodia, Schistostephium heptalobum and Tephrosia shiluwanensis, with occasional small Conyza ulmifolia and Helichrysum mundii. Two species of occasionally encountered woody or subwoody waterside grasses may be mentioned here. Depauperate specimens of Phragmites communis may occur in the better-lit waterside situations where the soil and water are sufficiently deep. Pennisetum natalense is an isolated colonist of wet boulders or the rocky banks in the more sunny parts of the watercourse.

(2) Smaller Softer Herbs and Ferns. Dominating the field layer are the sedge Carex spicato-paniculata, usually at least some distance away from the water, and the subwoody fern Osmunda regalis, which forms a distinct zone densely fringing the water's edge for long sections of the stream banks. The more abundant associated plants of this sublayer are the following:

Thelypteris bergiana
Setaria chevalieri
Plectranthus nummularis
Oplismenus hirtellus
Pellaea viridis
Thelypteris palustris var. *
Aneilema aequinoctiale
Crassula thorncroftii *
Ischaemum arcuatum
Leersia hexandra *
Cyperus albostriatus
Haemanthus magnificus
Hypoxis angustifolia
Commelina diffusa
Panicum aequinerve *
P. hymeniochilum var. *
Crinum macowanii
Hemarthria altissima
Aristea ecklonii
Gerbera jamesonii (edge)
Paspalum commersonii
*P. urvillei
Pteridium aquilinum
Centella coriacea *
Oldenlandia goreënsis *

(F) GROUND LAYER

Liverworts, especially Marchantia wilmsii, are abundant on moist rocks of the river-bed and bank. Numerous mosses are present in extensive mats or, more commonly, small colonies on rocks, e.g. Sematophyllum brachycarpum, and on the creeping surface roots of Adina microcephala var. galpinii, e.g. Erythrodontium abruptum and Tortella petrieana, as well as on the bare soil portions of the banks, where colonies occur in smaller, less pure stands. Selaginella mittenii occurs as a rarity in very sheltered, shady damp rock niches in steep parts of the bank. Although Richards et al. (1940) class species of Selaginella as field-layer constituents, S. mittenii is here considered to be a ground-layer component in view of the low, moss-like appressed habit.

(G) LIANOID PLANTS

(1) Lianes and Scramblers. The most characteristic of the more robust lianoid plants are Dalbergia armata and Smilax kraussiana. The latter frequently reaches the canopy, especially the lower outer portions. Associated scramblers and lianes are Acacia ataxacantha and Bauhinia galpinii, with isolated *Passiflora edulis, Rubus pinnatus, Secamone alpinii and Adenia gummifera.

(2) Softer Slender Climbers. Of the less robust lianoid plants not reaching the canopy, the more abundant species are Abrus fruticulosus, Smilax kraussiana, Dioscorea cotinifolia, Adenia digitata, Cissampelos torulosa, Thunbergia alata and *Passiflora edulis.

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* Mostly confined to permanently or semipermanently moist topsoil.

(H) EPIPHYTES

Epiphytic plants are found in abundance on rough-barked trees such as species of Syzygium, Bridelia, Combretum and Antidesma, and, particularly, Adina microcephala var. galpinii. The more numerous vascular epiphytes are probably the orchids, as indicated below:

Bulbophyllum sandersonii predominates in terms of numbers of plantlets and overall cover where it does occur, although it is largely restricted to the stout limbs and stems of old trees of Adina microcephala var. galpinii, beneath the canopy.

Mystacidium venosum is not restricted to rough bark and, although individual plants are small and inconspicuous, it grows very abundantly on stems, branches and twigs of all manner of canopy and understory trees, scramblers and lianes, beneath the canopy.

Probably next in order of abundance is Jumellea filicornoides, forming large tufts of semipendulous ascending stems, usually high up on trunks and branches of species of Syzygium and, especially, of Adina, but underneath the canopy.

The scattered small tufts and individual plants of Polystachya sp., aff. P. zambesiaca, are probably far less in number than those of the aforementioned species. Nevertheless, nearly every full-grown rough-barked tree of the canopy and understory probably carries a few of these plants.

The epiphytic ferns Pleopeltis macrocarpa and Polypodium polypodioides subsp. ecklonii grow fairly frequently on rough-barked trees, more particularly A. microcephala var. galpinii.

The remaining epiphytic orchids are rather less frequent. Cyrtorchis arcuata seems rather to be more associated with Syzygium cordatum. It grows high up where there is more light and warmth, usually beneath the canopy, but sometimes in very open exposed places. Cyrtorchis praetermissa appears to favour old specimens of A. microcephala var. galpinii more than Syzygium spp., probably because the foliage is not so dense and shady. It always grows well up in the crowns and can withstand intense sunshine to a remarkable degree, being very tolerant of drought and heat. Old, moribund and even dead trees of A. microcephala var. galpinii often carry surprisingly large populations of C. praetermissa, looking none the worse for their exposed situation.

Oberonia disticha appears to be rather rare. This succulent orchid is, however, very small and inconspicuous and easily overlooked, especially as it appears to grow fairly high up on steep trunks in deep shade, as a rule.

Polystachya similis occurs only rarely on this site.

Stenoglottis fimbriata var. saxicola is apparently also rare here although it is easily overlooked. It does, however, appear to prefer higher altitudes, as do the ferns Asplenium aethiopicum and A. rutaefolium which are relatively rare in this community. The angiospermous Peperomia reflexa and Polystachya imbricata occur here as rare epiphytes. Depauperate Aerangis kotschyana has been seen to occur as a rarity but A. mystacidii, typical of higher altitudes, appears to be absent. Plectranthus nummularis may also grow as a facultative epiphyte on rough-barked old riverside trees, especially in the lower crotches.

The epiphytic orchid Ansellia gigantea var. gigantea has been observed to grow sporadically in seral and climax communities along rivers and streams up to the Mistbelt, but it appears to grow as well or better away from water.

In addition to vascular epiphytes, many epiphytic lichens and mosses are found, particularly on Adina microcephala var. galpinii. Numerous foliose lichens in the sunnier upper parts of the canopy crowns create a niche for a specialised invertebrate fauna. Mosses are the predominant epiphytes on the lower boles where they often form extensive mats. Noteworthy examples are Erythrodontium abruptum and Tortella petrieana. These epiphytic mosses are also found on the large sprawling roots of Adina microcephala var. galpinii, which characterise the waterside stretches of this community.

2.3 ECOLOGICAL NOTES

About half the tree species present are deciduous or semideciduous but the majority of the more important canopy and overstory trees are evergreen.

The codominants of this community are among the earliest pioneers of the succession on rocky river-banks (cf. p.67 et seq.). Adina microcephala var. galpinii is remarkable for the peculiar ability of its seedlings to establish themselves in small crevices in boulders and solid bedrock along watercourses and to endure extremes of heat and drought as well as periodic submersion. In the course of time, stout roots, spreading over the rock surface and penetrating crevices and soil pockets, are typically developed. These roots serve to anchor the trees securely against flood-waters as well as to take up water and nutrients wherever these may be accessible.

Syzygium cordatum, Ficus capensis, Adina microcephala var. galpinii and Anthocleista grandiflora show slight buttressing. The formation of prop roots by A. grandiflora and Bridelia micrantha has already been mentioned (see p.96).

It is evident that the distribution of epiphytes is closely related to the microclimate as well as to the roughness of the substratum. The decisive microclimatic factors are the correlated factors of shade and humidity associated with the cool damp atmosphere below the canopy, as contrasted with conditions of exposure to more intense sunshine, heat and desiccation obtaining in and above the canopy. With the exception of certain hardy lichens, mosses and *Cyrtorchis praetermissa*, the epiphytes of this gallery forest are mostly shade epiphytes (see Richards, 1952).

3. SYZYGIUM CORDATUM-BRIDELIA MICRANTHA-FICUS CAPENSIS ASSOCIATION

3.1 HABITAT

Another stretch of gallery forest is found on the banks of the Mtataspruit and an adjoining gully at about 900 m above sea level. The vegetation of this forest is in some respects intermediate between that of the two preceding examples of riparian forest. This is probably to be accounted for by the habitat being intermediate in respect of soil factors. Here rich alluvial and colluvial soil over rocky subsoil and bedrock form the banks and bed of the stream.

The following description is based on the only available stand of this vegetation type. The vegetation has suffered much disturbance because this is a much-frequented spot and, especially, since a road has been cut through the forest.

3.2 STRUCTURE AND COMPOSITION

Although this gallery forest resembles the previously described *Adina-Syzygium* species Association in exhibiting a zonation parallel to the stream and in the canopy normally becoming progressively lower away from the stream, horizontal stratification can usually be made out without undue difficulty. Because of the marked differentiation of the stream-bank zone, species found more commonly on the stream-banks are indicated by a superscript cipher $^{"1"}$, while the names of species occurring more commonly away from the stream-banks are followed by the superscript number $^{"2"}$.

Some nine or ten synusiae can be distinguished as follows:

Plate 16. Interior view of Syzygium cordatum-Bridelia micrantha-Ficus capensis gallery forest, with emergent Anthocleista grandiflora in middle distance.

(A) OVERSTORY

The only emergent tree is *Anthocleista grandiflora* which reaches up to a height of about 25 m in places (see Plate 16).

(B) CANOPY

The canopy varies from irregularly closed, especially along the stream, to discontinuous, especially away from the stream where the spacing of trees is very irregular. It is also variable in height - from less than 10 m to 15 m along the outskirts to over 20 m in height over the water. The dominant tree of the whole community is *Syzygium cordatum*[1], which is particularly abundant on the stream-banks where it is associated more especially with the species marked [1] below. Sub-dominant are *Bridelia micrantha*[1] and *Ficus capensis*[2] associated with *Adina microcephala* var. *galpinii*[1], *Antidesma venosum*[2], *Syzygium guineense*[1], *Anthocleista grandiflora*, *Combretum gueinzii*[2] (especially outer edges), *Cussonia spicata*[2] (forest form), *Trema orientalis*[2] and *Combretum erythrophyllum*[2].

Nuxia floribunda occurs in about equal abundance in both situations. Other canopy trees are *Erythrina lysistemon*, *Ilex mitis*[1], *Mimusops zeyheri*, *Maytenus peduncularis* and *Pittosporum viridiflorum*. *Rauvolfia caffra*[1] occurs where there is sufficient light and water. *Trichilia* sp. (*T. dregeana*? *T. emetica*?) grows on the steep south-facing rocky banks.

Euclea crispa, *Heteropyxis natalensis* and *Maesa lanceolata* may also contribute to the canopy on the outskirts of the gallery forest together with such species as *Peltophorum africanum*, *Ziziphus mucronata*, *Acacia ataxacantha*, *A. karroo* and *Antidesma venosum*.

(C) UNDERSTORY

Apart from the numerous transgressives, this stratum consists chiefly of the following small trees:

Antidesma venosum 2
Heteromorpha trifoliata 2
Trimeria grandifolia 2
Canthium inerme 1
Eugenia natalitia 1
Maesa lanceolata 2
Euclea crispa 2

Halleria lucida
Tricalysia capensis 1
**Psidium guajava* 2
Oxyanthus gerrardii 1
Maytenus heterophylla 2
M. mossambicensis var.
Allophylus transvaalensis (occasional)

Maytenus peduncularis[2] and *Xymalos monospora* were formerly present as fair-sized trees but probably did not reach the canopy.

(D) SHRUB LAYER

This stratum, 1 m to 2 m in height, is rather poorly developed on the whole, except for transgressive trees. The more important mature plants in this layer include Vernonia ampla[2] (especially on disturbed sites), Grewia occidentalis[2], Plectranthus fruticosus[1], Flemingia grahamiana[2], Cyathea dregei[1], Pavetta barbertonensis[2], Marattia fraxinea var. salicifolia[1] and Vangueria infausta.

(E) FIELD LAYER

The plants of this stratum, up to about 1 m tall, fall into two subclasses, on the basis of habit, degree of woodiness and, to a lesser extent, size:

(1) Taller, Subwoody Forbs and Undershrubs. This subclass is well represented, particularly away from the stream-banks. It consists mainly of the following plants:

Dicliptera clinopodia 2
Desmodium repandum 2
Phaulopsis imbricata 2
Endostemon obtusifolius
Plectranthus laxiflorus 1
Hibiscus vitifolius subsp. 2
(open disturbed sites)
Stachys grandifolia 2
Argyrolobium tomentosum 1
Schistostephium heptalobum 2
Pouzolzia parasitica 2
Sida rhombifolia 1 (forest form)
Tephrosia shiluwanensis 2
Pycnostachys urticifolia
Clutia affinis 1 (under open canopy)
Conyza ivaefolia
Pseudarthria hookeri
Rhoicissus tridentata

(2) Low Soft Herbs and Ferns. This sublayer is well developed, especially on the stream-banks. It is dominated by grasses, sedges and grass-like plants, viz. Carex spicato-paniculata[2], Oplismenus hirtellus, Setaria chevalieri[2], Aneilema aequinoctiale and the fern Thelypteris bergiana. Associated plants are:

Asparagus virgatus 2
Cyperus albostriatus 2
Osmunda regalis 1 (waterside)
Pellaea viridis 2
Impatiens duthieae 1
Galopina circaeoides 2
Dietes vegeta 1
Selaginella kraussiana 1
Pteris catoptera 2
Microstegium capense 1 (alluvial sandy silt)
Achyranthes aspera 2 (disturbed)
Centella coriacea 1 (disturbed)
Spilanthes mauritiana 2 (disturbed)
*Eupatorium rugosum 1
Adenostemma perottetii 1
Coleus rehmannii 1
Drymaria cordata subsp. 1
Ischaemum arcuatum 1 (open canopy)
Lapeirousia grandiflora 1
Leersia hexandra 1
Crassula thorncroftii 1
Zantedeschia tropicalis 2
*Canna indica 1 (disturbed)
Cyperus distans 1
Dichondra repens 2 (disturbed)
Ehrharta erecta 1
Dryopteris inaequalis 2
Tectaria gemmifera 1
Triumfetta pilosa var. effusa 2 (disturbed)
Hyparrhenia gazensis 2 (open canopy)
Panicum monticolum 1
Pavonia columella 2
Pennisetum natalense 1
Thunbergia natalensis 1
Agrostis lachnantha 1
Monopsis stellarioides 1
Blechnum attenuatum 1
Commelina diffusa 2
Hydrocotyle americana 1
Mariscus sieberianus 2 (disturbed)
Pentas micrantha subsp. 1
Pteridium aquilinum 2
Vernonia hirsuta 2
Cassia mimosoides 2
Commelina benghalensis 2
Conyza hochstetteri 1
Crotalaria distans 2
Cyperus haspan 1
Cyphia elata 2
Eulophia streptopetala 2
Haemanthus magnificus 1
Helichrysum mundii 1 (open canopy)
Hypoxis angustifolia
Impatiens sylvicola 1
Indigofera schinzii 2
Kyllinga melanosperma 1
Mariscus congestus 1
Panicum aequinerve 1
Peucedanum venosum

In addition to the above, the ground orchid Calanthe natalensis formerly grew on rock ledges, sheltered by a low cliff on the north bank and kept permanently wet by dripping and running seepage water. These plants have probably been removed by picnickers. This species and the giant herb Ensete ventricosum are normally found in marshy places and along creeks in the vegetation zones above 900 m, although outliers of E. ventricosum are known from below this altitude. The latter also occurs in this community but has not been seen to attain maturity here (see Plate 17).

(F) GROUND LAYER

This layer consists mostly of Hepaticae, notably Marchantia wilmsii, which occurs abundantly on rocks and earth banks along the Mtataspruit. Numerous Jungermanniales occur with some mats of the thallose liverwort Dumortiera hirsuta on rocks kept permanently wet by dripping and trickling water.

(G) LIANOID PLANTS

(1) Lianes and Scramblers. The dominant liane is Dalbergia armata,

particularly along the stream banks. The following more woody or robust scandent and subscandent plants are also capable of reaching the canopy although they may do so only when it is low:

<u>Acacia ataxacantha</u> 2	<u>Helinus integrifolius</u> 2
<u>Rhoicissus tomentosa</u> 2	*<u>Passiflora edulis</u> 2
<u>Rubus pinnatus</u> 1	<u>Rhoicissus rhomboidea</u> 1
<u>Smilax kraussiana</u> 1	<u>Asparagus falcatus</u>
<u>Mikania cordata</u> 2	<u>Bauhinia galpinii</u> 2
<u>Adenia gummifera</u> 1	<u>Entada spicata</u> 1
<u>Choristylis rhamnoides</u> 1	<u>Ipomoea wightii</u> 2
<u>Canthium gueinzii</u> 1	<u>Riocreuxia torulosa</u> 1
<u>Combretum gueinzii</u> 2 (lianoid)	<u>Senecio deltoideus</u> 2
<u>Secamone alpinii</u> 1	<u>S. tamoides</u> 1
<u>Cephalanthus natalensis</u> 1	<u>Solanum bifurcum</u> 1

Despite the irregular heights and spacing of the trees, these climbers serve to knit the canopy together to an appreciable degree in places.

(2) <u>Soft Slender Climbers.</u> The most abundant species of the less robust lianoid plants not reaching the canopy is <u>Dioscorea cotinifolia</u>[2]. Associated species are:

<u>Cissampelos torulosa</u> 2	<u>Dioscorea retusa</u> 2
<u>Smilax kraussiana</u> 1	<u>Glycine javanica</u>
<u>Canavalia virosa</u> 2	<u>Hewittia sublobata</u> 2
<u>Thunbergia alata</u> 2	<u>Rhynchosia albiflora</u> 2
<u>Dumasia villosa</u> 2	<u>Trochomeria hookeri</u> 1
<u>Jasminum streptopus</u> var. 2	<u>Asparagus saundersiae</u> (subscandent)
<u>Abrus fruticulosus</u> 2	<u>Cayratia gracilis</u>
<u>Ctenomeria capensis</u> 1	<u>Coccinia</u> sp. (<u>C. adoensis?</u>)
<u>Adenia digitata</u> 2	<u>Dolichos lablab</u>
<u>Behnia reticulata</u> 1	<u>Riocreuxia torulosa</u>
*<u>Passiflora edulis</u> 2	<u>Senecio deltoideus</u>
<u>Rhynchosia caribaea</u>	<u>S. tamoides</u>
<u>Stephania abyssinica</u>	<u>Vigna vexillata</u>
<u>Cyphostemma cirrhosum</u> subsp.	<u>Cyathula cylindrica</u> (subscandent)

(H) EPIPHYTES

Lichens and mosses clothing the bark of the larger trees, especially near the stream are sometimes very numerous. Rather more conspicuous on the larger trees overhanging the stream, particularly on <u>Adina microcephala</u> var. <u>galpinii</u>, are the vascular epiphytes. These include <u>Mystacidium venosum</u>, <u>Peperomia reflexa</u>, <u>Jumellea filicornoides</u>, <u>Polystachya</u> sp., aff. <u>P. zambesiaca</u>, <u>P. imbricata</u>, <u>Stenoglottis fimbriata</u> var. <u>saxicola</u> and <u>Pleopeltis macrocarpa</u>, with occasional <u>Aerangis mystacidii</u> and <u>Polypodium polypodioides</u> subsp. <u>ecklonii</u>. <u>Asplenium aethiopicum</u>, <u>A. rutaefolium</u> and <u>A. splendens</u> are rather rare here. The succulent herb <u>Kalanchoe rotundifolia</u> has also been observed to grow as a facultative epiphyte on

Plate 17. Aerial roots of Anthocleista grandiflora in Syzygium cordatum-Bridelia micrantha-Ficus capensis Gallery Forest, small Ensete ventricosum at right.

old rough-barked *Adina microcephala* var. *galpinii*.

(I) PARASITES

The only heterotrophic plants noted are very occasional specimens of *Alectra orobanchoides* near the transition from gallery forest to scrub, where this species may be locally fairly frequent. This small herb is holoparasitic on roots, especially of the Acanthaceous undershrubs *Phaulopsis imbricata* and *Dicliptera clinopodia*, but its influence in the gallery forest is of little account.

3.3 ECOLOGICAL NOTES

As in the previously described gallery forest, the tree strata are predominantly evergreen. Physiognomic aspects are also similar. *Anthocleista grandiflora* and *Bridelia micrantha* develop prop roots in suitable microhabitats (see Plate 17). A measure of buttressing is manifested by *Syzygium cordatum*, *Ficus capensis*, *Adina microcephala* var. *galpinii*, *Anthocleista grandiflora* and *Cussonia spicata* (forest form).

Vegetative spread results in local aggregation of *Ficus capensis* (see p. 96) and *Dietes vegeta*. Plantlets arising from the tips of prolongations of the inflorescence axes strike root when these bend down and trail along the ground.

In addition to typical components of the Lowveld Sour Bushveld Transition Zone, this gallery forest contains some elements of the Scrub Forest and High Forest Belts. This is understandable in view of its situation at about 900 m altitude, which is about the average elevation of the transition from the Savanna Woodland Belt to the Scrub Forest Belt. This is the highest level at which *Adina microcephala* var. *galpinii* appears to grow naturally on Westfalia Estate. Canopy and understory trees present here but more typical of higher elevations are the "forest form" of *Cussonia spicata*[2], *Nuxia floribunda*[2], *Maytenus peduncularis*[2], *Trichilia dregeana*[1]?, *Trimeria grandifolia*[1], *Brachylaena transvaalensis*[2], *Eugenia natalitia*[1], *Maytenus mossambicensis* var. *mossambicensis*, *Oxyanthus gerrardii*[1], *Tricalysia capensis*[1] and *Xymalos monospora*[1]. Shrubby plants which typically grow at higher altitudes are *Plectranthus fruticosus*[1] and *Pavetta barbertonensis* and the woody ferns *Cyathea dregei*[1] and *Marattia fraxinea* var. *salicifolia*[1]. More typically high-altitude herbaceous plants include *Desmodium repandum*[2], *Argyrolobium tomentosum*[1], *Galopina circaeoides*[2], *Dietes vegeta*[1], *Coleus rehmannii*[1], *Ehrharta erecta*[1], *Panicum monticolum*[1], the "forest form" of *Sida rhombifolia*, *Thunbergia natalensis*[1] and *Blechnum attenuatum*[1]. Also typical of greater elevations are the lianes and scramblers Canthium gueinzii[1], Cephalanthus natalensis[1], Rhoicissus rhomboidea[1], Asparagus falcatus and Entada spicata[1] and the soft twiners Ctenomeria capensis[1], Behnia reticulata[1], Dioscorea retusa[2], Riocreuxia torulosa[1], Senecio tamoides[1] and Solanum bifurcum[1]. Epiphytes more typical of higher levels are Peperomia reflexa[1], Polystachya imbricata[1], Pleopeltis macrocarpa[1], Polypodium polypodioides subsp. ecklonii[1], Aerangis mystacidii[1], Asplenium aethiopicum[1], A. rutaefolium[1] and A. splendens[1].

The affinities of this gallery forest with the vegetation of the High Forest Belt are also revealed in the transgressive flora, e.g. Ochna holstii, Combretum kraussii, Scolopia zeyheri and Harpephyllum caffrum. Transgressive trees suggest that the composition of this gallery forest might well undergo further succession if left undisturbed. In such an event, increases in the relative abundance of the following species could be expected:

Bridelia micrantha 2	Trimeria grandifolia 1
Ficus capensis 1	Combretum erythrophyllum 2
Antidesma venosum 2	C. gueinzii 2
Allophylus transvaalensis 2	Ziziphus mucronata 2
Anthocleista grandiflora 2	Cussonia spicata 2
Maytenus peduncularis 2	Ochna holstii 1
Maesa lanceolata	Euclea crispa 2
Nuxia floribunda 2	Maytenus heterophylla 1
Syzygium guineense 2	M. mossambicensis var. 1
Trema orientalis 2	Pittosporum viridiflorum 1
Ilex mitis 1	Halleria lucida 1
Dombeya burgessiae 2	Mimusops zeyheri

It will be seen that most of the above transgressives occur away from the stream banks. Along the stream-banks the regeneration is predominantly of Syzygium cordatum and Adina microcephala var. galpinii which will almost certainly continue to dominate the waterside sites.

CHAPTER V

THE SCRUB FOREST BELT

The Scrub Forest Belt extends, on the average, from about the 900 m to about the 1200 m levels, spanning the transition between the two broad climatic belts, the Low Country and the Mistbelt. It consists of two zones, viz. the Low Scrub Forest Zone and the High Scrub Forest Zone, falling into the Low Country and the Mistbelt, respectively, and these will be dealt with in that order in the following account.

A. THE LOW SCRUB FOREST ZONE

The Low Scrub Forest Zone, situated mainly between about 900 m and 1050 m elevation, has been inhabited and, more particularly, utilised by both the Bantu and White settlers from before historical times to the present day. Very little, if any, vegetation can be considered to approach a natural condition, except for swamp and riparian communities and even these usually show obvious signs of human interference. At present, by far the greater part of this zone consists of orchards, eucalypt plantations, planted pastures, nurseries, human habitations, cultivated land and gardens, and secondary communities. Old cultivated lands and *Trema* plantations that were gradually reverting to scrub, especially on the lower slopes of the Central Hill, have largely been cleared for large-scale planting to citrus under irrigation since the building of the Nokeng-e-Chweu Dam. Various stages of subseral scrub on the southern slopes of Piesang Kop have also been cleared for orchards and plantations from time to time.

No information on the priseres is available because there were no primary bare areas or primary plant communities to be seen.

The strips of gallery forest in this zone are narrow and discontinuous. If well developed, they would probably resemble that on the lower boundary of this zone (see p. 102-8), except that *Adina microcephala* var. *galpinii* and *Syzygium guineense* would probably be absent. *Syzygium cordatum* predominates in riparian and swamp forest with greater or lesser numbers of associated plants notably *Bridelia micrantha*, *Ficus capensis* and *Anthocleista grandiflora*. Typical epiphytic orchids are *Polystachya* sp., aff. *P. zambesiaca*, *P. imbricata* and *Mystacidium venosum*, with increased *Aerangis mystacidii* and the entry of *P. ottoniana*. *Jumellea filicornoides* seems to disappear, together with *Adina microcephala* var. *galpinii*, at altitudes above about 900 m. Rare trees encountered at higher altitudes in kloof and gallery forest include *Suregada procera* and *Trichocladus ellipticus*.

Secondary succession is essentially similar throughout the Low Country (see "Old Land" Succession on Red Ferrallitic Soils, p. 1-4 , Appendix A).

Characteristic species of subseral scrub and scrub forest are notably Acacia ataxacantha, with Acacia davyi, Antidesma venosum, Bauhinia galpinii, Bridelia micrantha, Parinari curatellifolia subsp. mobola, Smilax kraussiana, Cassytha ciliolata, Combretum gueinzii, Dombeya burgessiae, D. rotundifolia, Euclea crispa, Faurea saligna, F. speciosa, Ficus capensis, Hermannia floribunda (localised), Mucuna coriacea, Trema orientalis, Vernonia ampla and V. shirensis. Species which appear to be more frequent away from water in this zone than they are in the Lowveld Sour Bushveld Transition Zone include Acacia ataxacantha, Anthocleista grandiflora, Antidesma venosum, Bauhinia galpinii, Bridelia micrantha, Dombeya burgessiae, Ficus capensis, Maesa lanceolata, Smilax kraussiana, Syzygium cordatum, Pittosporum viridiflorum, Rauvolfia caffra and Rhus intermedia. Lowveld Sour Bushveld elements which may be present in the Low Scrub Forest Zone include Annona senegalensis, Faurea saligna, Peltophorum africanum, Pterocarpus rotundifolius, P. angolensis and Strychnos spinosa. Typical associated scrub and scrub forest plants include Asparagus saundersiae, Canthium huillense, C. inerme, Helichrysum panduratum, Hermannia floribunda, Hibiscus altissimus, Hyparrhenia gazensis, Littonia modesta, Peucedanum venosum, Phaulopsis imbricata, Setaria chevalieri, and Vernonia corymbosa. In addition to the more widely distributed Syzygium cordatum, Ficus capensis, Bridelia micrantha, Sesbania macrantha var. levis, Ischaemum arcuatum, Epilobium salignum, Cyperaceae and others (see p. 111), several more restricted species are found in swampy hollows, "kommetjies" and seepage areas. These more restricted hygrophilous plants include Eulophia angolensis, Gladiolus papilio, Helichrysum sp., cf. H. odoratissimum, Inula paniculata and Phyllanthus meyerianus.

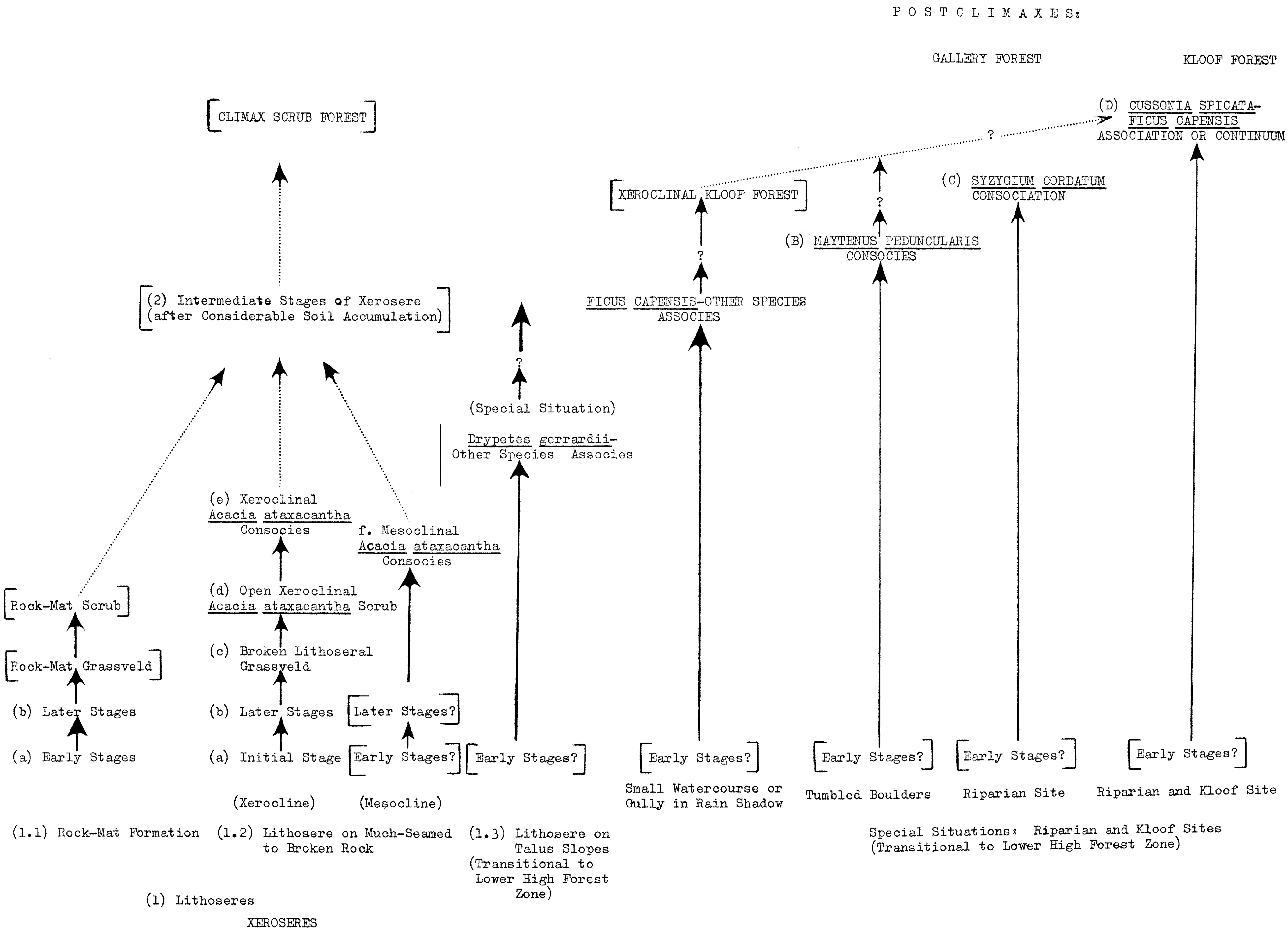

Fig. 7. Suggested successional trends and interrelationships of primary plant communities in the High Scrub Forest Zone. Communities enclosed in square brackets are hypothetical.

B. THE HIGH SCRUB FOREST ZONE

The High Scrub Forest Zone lies in the Mistbelt, for the most part between 1050 m and 1200 m altitude although it extends up to considerably higher levels on xeroclines, as on the northern slopes of Piesang Kop, where rain-shadow effects effectively prevent the establishment of typical High Forest Belt vegetation except near the summit. Although much utilised and disturbed, this zone has not suffered disturbance to the extent experienced in the Low Scrub Forest Zone and some relict plant communities are to be found in a presumably nearly natural state.

PLANT SUCCESSION

Information on succession is incomplete because very little can be seen or inferred concerning the hydrosere beyond supposing it to resemble that of the Low Country in most essentials. The suggested successional trends and interrelationships of primary plant communities are indicated in Fig. 7.

1. PRISERES

(A) THE HYDROSERE

The building of the Nokeng-e-Chweu dam in Rosendal will afford opportunities for observations on early hydroseral stages only after the water has been standing for sufficient length of time.

Open swamp communities in "kommetjies" and seepage areas are characterised mainly by Cyperaceae with *Ischaemum arcuatum*, occasional *Leersia hexandra*, *Pennisetum macrourum*, *Typha latifolia* subsp. *capensis*, *Thelypteris palustris* var. *squamigera*, *Alchemilla rehmannii*, *Epilobium salignum*, *Helichrysum* sp., cf. *H. odoratissimum*, *H. mundii*, *H. umbraculigerum*, *Hydrocotyle americana* and *Phyllanthus meyerianus*.

Swamp forests are fairly frequent in this zone and resemble those of other zones in that *Syzygium cordatum* predominates in the tree layer. *Syzygium cordatum* is quite often accompanied by occasional *Anthocleista grandiflora* (canopy and emergent), *Bridelia micrantha*, *Ficus capensis*, *Rauvolfia caffra* and other trees. Lianoid plants include *Behnia reticulata*, *Ceratiosicyos laevis*, *Dalbergia armata*, *Rhoicissus rhomboidea*, *R. tomentosa*, *Riocreuxia torulosa*, *Smilax kraussiana* and *Stephania abyssinica*. The undergrowth commonly consists of species of *Cyperus*, *Kyllinga* and *Pycreus*, *Scirpus macer* and other Cyperaceae, *Thelypteris bergiana*, *T. palustris* var. *squamigera*, sometimes *Cyathea dregei*, *T. madagascariensis* and other ferns, *Dietes vegeta* and other species with

Calanthe natalensis as a rarity.

For the rest, hydrarch communities are sufficiently developed to be regarded as postclimax communities and they will therefore be discussed at a later stage (see p. 130 *et seq.*).

(B) THE XEROSERES

(1) The Lithoseres. Primary areas of exposed granite-gneiss bedrock are confined to a small sheet on the northeastern face of the Central Hill and more extensive outcrops on the northern to northwestern slopes of Piesang Kop. Bare diabase outcrops have not been seen, all dykes seemingly carrying more advanced stages of grassland, scrub and scrub forest apparently not differing significantly from those developed on granite-gneiss outcrops. The seres initiated on granite-gneiss can be dealt with under three heads according to whether the rock surface is found in unbroken sheets, or seamed, jointed and broken or as scree.

(1.1) Rock Mat Formation. The only sere of this type in this zone has been encountered on a northeast-facing sheet of granite-gneiss inclined at about 20° to 25° from the horizontal. This sheet is not much seamed except to some extent in the lower portion. The upper portion is, however, in the process of having pockets and runnels scoured out by gritty sandy silt washing over the surface from the more developed parts of the rock mat lying higher upslope. This sandy silt also collects in pockets and crevices.

(a) Early Stages. The seams, crevices, runnels and pockets, especially in the lower portion, are colonised by small to fairly large tufts of the Cyperaceous *Coleochloa setifera*, which appear to initiate the succession here. It is followed by *Pellaea viridis*, *Panicum maximum*, *Crassula muscosa* (rare here), *C. rubicunda*, *Kalanchoe rotundifolia*, *Sporobolus stapfianus*, *Aloe greatheadii* and *A. lettyae*, with occasional *Commelina diffusa*, *Eragrostis curvula*, *Loudetia simplex*, *Rhynchelytrum repens*, *Schizachyrium semiberbe*, *Senecio orbicularis*, *Trachypogon spicatus*, *Cyperus albostriatus*, *Cyphostemma woodii*, *Eulophia streptopetala* and *Hyparrhenia hirta*. An isolated specimen or two of *Drimia sphaerocephala* may occur in tufts of *Coleochloa setifera*.

(b) Later Stages. Tufts of *Coleochloa setifera* increase in size with simultaneous increase in numbers of *Loudetia simplex*, *Rhynchelytrum repens*, *Schizachyrium semiberbe*, *Trachypogon spicatus*, *Eragrostis capensis*, *E. curvula* and *Cymbopogon validus*. The accumulation of organic material and soil is marked by the entry into the sere of such forbs as Aspilia africana, Vernonia natalensis, Eriosema cordatum var. gueinzii and Athrixia phylicoides. The foregoing herbaceous and sub-woody pioneers are accompanied or soon followed by such woody plants as Iboza riparia, Lannea edulis, Parinari curatellifolia subsp. mobola, Vangueria infausta, Combretum gueinzii, Dichrostachys cinerea subsp. nyassana, Heteropyxis natalensis, and *Psidium guajava, with occasional Rhus rehmanniana, Acacia ataxacantha and Bridelia micrantha. Albizia versicolor is present as an isolated Lowveld Sour Bushveld element. The lianoid Sphedamnocarpus galphimiifolius also enters at this stage.

Species of Ramalina and Usnea may be conspicuously abundant even on quite small trees, especially Parinari curatellifolia subsp. mobola. These epiphytic lichens bear witness to the fairly frequent presence of mist.

In the deeper soil accumulations, the above-mentioned species are accompanied by several shrubs and suffrutices including Pseudarthria hookeri, Flemingia grahamiana and, especially when shaded, Phaulopsis imbricata. The development of a scrub community appears likely in due course. Prominent components of such a scrub community would be Acacia ataxacantha, Bridelia micrantha, Combretum gueinzii, Heteropyxis natalensis, Parinari curatellifolia subsp. mobola, Phaulopsis imbricata, Rhus rehmanniana, Sphedamnocarpus galphimiifolius and Vangueria infausta.

(1.2) Lithosere on Much-Seamed to Broken Rock. Examples of succession on much-seamed and broken rock surfaces may be found on the lower northwestern slopes of Piesang Kop, on Christinasrust. The lithoseral stages of the lower levels (about 1200 m to 1300 m) may be considered to fall into the High Scrub Forest Zone, transitional to the Lower High Forest Zone into which the upper levels fall. These slopes provide a striking example of the way in which vegetational and climatic zones are raised on the xeroclines. Rain-shadow effects are locally marked.

(a) Initial Stages. The initial stages of succession on much-seamed, steep faces are here characterised by the strong development of Vellozia villosa, with rows of Strychnos spinosa becoming established in the seams and joints of the otherwise more or less solid granite-gneiss at an early stage. Succession in the crevices is initiated by the following species:

<u>Coleochloa setifera</u>
<u>Vellozia villosa</u>
<u>Loudetia simplex</u>
<u>Crassula</u> sp., aff. <u>C. nodulosa</u>
<u>C. muscosa</u>
<u>C. rubicunda</u>
<u>Kalanchoe rotundifolia</u>
<u>Aeolanthus rehmannii</u>
<u>Aloe greatheadii</u>
<u>A. lettyae</u>
<u>Kalanchoe thyrsiflora</u>
<u>Notholaena ecklonii</u>
<u>Pellaea viridis</u>
<u>Chlorophytum bowkeri</u>
<u>Cryptolepis oblongifolia</u>
<u>Pelargonium luridum</u>
<u>Pellaea calomelanos</u>
<u>Senecio orbicularis</u>
<u>S. othonniformis</u>
<u>Iboza riparia</u>
<u>Ficus ingens</u>

The above species are accompanied or soon followed by <u>Strychnos spinosa</u> and solitary <u>Sclerocarya birraea</u> testifying to the affinities with the Low Country.

(b) <u>Later Stages.</u> As the substratum becomes more stabilised, woody plants become more frequent. The more common woody plants at this stage are, especially, <u>Combretum gueinzii</u>, <u>Acacia ataxacantha</u>, <u>Faurea speciosa</u> (on more broken parts), <u>Greyia radlkoferi</u>, <u>Lannea discolor</u>, <u>Dombeya rotundifolia</u> and <u>Vangueria infausta</u>, with occasional <u>Euclea crispa</u>, <u>Indigofera adenioides</u>, <u>I. swaziensis</u>, <u>Lannea edulis</u>, with isolated <u>Anthospermum ammanioides</u> and <u>Heteromorpha transvaalensis</u>. The grasses include <u>Panicum maximum</u> and <u>P. natalense</u> with occasional <u>Aristida transvaalensis</u>, <u>Rhynchelytrum repens</u>, and <u>Stereochlaena cameronii</u>. Both <u>R. repens</u> and <u>S. cameronii</u> may produce stolons which creep over and colonise bare rock surfaces.

It seems likely that the large-scale establishment of grasses here would give rise to a type of broken grassveld similar to that found on the less steep, broken rocky surface lower downslope, as described below.

(c) <u>Broken Lithoseral Grassveld.</u> A short distance below and approximately northwest of the steep rock faces of the northwestern slopes of Piesang Kop is found a fairly dense open grassveld consisting chiefly of <u>Loudetia simplex</u>, <u>Schizachyrium semiberbe</u>, <u>Trachypogon spicatus</u>, <u>Setaria flabellata</u> and <u>S. sphacelata</u>, with scattered <u>Cymbopogon validus</u>, <u>Eragrostis curvula</u> and <u>Sporobolus pyramidalis</u>. Associated forbs and ferns include the following species:

<u>Vernonia natalensis</u>
<u>Indigofera sanguinea</u>
<u>Pelargonium luridum</u>
<u>Hypoestes aristata</u>
<u>Eupatorium africanum</u>
<u>Justicia cheiranthifolia</u>
<u>Acalypha punctata</u>
<u>Anthospermum herbaceum</u>
<u>Aspilia africana</u>
<u>Gerbera glandulosa</u>
<u>Rhynchosia monophylla</u>
<u>Aloe greatheadii</u>
<u>A. lettyae</u>
<u>Kalanchoe rotundifolia</u>↑
<u>K. thyrsiflora</u>↑
<u>Pellaea calomelanos</u>↑
<u>Scilla natalensis</u>↑

The veld becomes more variable in composition with more lithophytes as one approaches the bottom of the rock faces higher up, as shown by the symbol ↑ above which signifies that the plants concerned become more important as one proceeds upwards towards the rock faces. In addition, several small trees occur, such as Combretum gueinzii, Rhus rehmanniana, Cussonia spicata, Dombeya rotundifolia, *Psidium guajava, Ziziphus mucronata, Parinari curatellifolia subsp. mobola and Vangueria infausta (on rock outcrops), with occasional Acacia ataxacantha, Canthium inerme, Erythrina lysistemon, Euclea crispa, Ficus capensis, Peltophorum africanum and Pterocarpus rotundifolius.

(d) Open Xeroclinal Acacia ataxacantha Scrub. This grassveld thickens up in due course and appears to be replaced by an open scrub consisting of the following plants:

Trees:

Acacia ataxacantha
*Psidium guajava
Euclea crispa
Parinari curatellifolia subsp.
Canthium inerme
Dombeya rotundifolia
Ficus capensis
Pittosporum viridiflorum (localised)
Maytenus heterophylla
Rhus rehmanniana
R. intermedia
R. chirindensis forma

Acacia davyi
Combretum gueinzii
C. kraussii
Dovyalis zeyheri
Erythrina lysistemon
Halleria lucida
Heteropyxis natalensis
Peltophorum africanum
Pterocarpus rotundifolius
Rhamnus prinoides
Rhus transvaalensis

Shrubs:

Vernonia ampla
Rhynchosia komatiensis
Flemingia grahamiana
Pseudarthria hookeri

Pycnostachys urticifolia
Lantana mearnsii
Lippia javanica
Rhoicissus tridentata

Low Soft Shrubs, Suffrutices and Tall Subwoody Forbs and Ferns:

Athrixia phylicoides
Hypoestes aristata
Polygala virgata
Artemisia afra
Laggera alata
Pavonia columella
Triumfetta pilosa var. effusa
Asparagus virgatus

Cineraria fruticetorum
Desmodium repandum (under trees)
Galopina aspera
Helichrysum lepidissimum
Justicia cheiranthifolia
Nidorella auriculata
Pteridium aquilinum
Schistostephium heptalobum

Grasses and Sedges:

Cymbopogon validus (dominant)
Schizachyrium semiberbe
Carex spicato-paniculata
Paspalum commersonii
Hyparrhenia gazensis

Eragrostis curvula
Loudetia simplex
Rhynchelytrum repens
Cyperus albostriatus
Panicum maximum
Setaria sphacelata

Low Forbs and Ferns:

Acalypha punctata
Gerbera glandulosa
Helichrysum nudifolium var.
Vernonia natalensis
Anthospermum herbaceum
Pellaea viridis
Conostomium natalense var.
Inula glomerata
Phyllanthus nummulariaefolius
Satureia biflora

Lianes and Scramblers:

Clematis brachiata, _Smilax kraussiana_ and _Carissa edulis_, in addition to _Acacia ataxacantha_.

Slender Twiners:

Asparagus africanus, the hemiparasitic epiphytic _Cassytha ciliolata_, _Stephania abyssinica_, _Tragia rupestris_ and _Vigna vexillata_.

By continued thickening up, a dense scrub may result such as that found on deeper soil below the sheet rock faces of the northern slopes of Piesang Kop, near the eastern boundary of Westfalia Estate's portion of Christinasrust, as described below.

(e) _Xeroclinal Acacia ataxacantha Consocies_. This closed scrub community is clearly dominated by _Acacia ataxacantha_ associated with much _Euclea crispa_ and accompanied by the following more important species:

Trees:

Rhus intermedia
R. rehmanniana
R. transvaalensis
Maytenus heterophylla
Bridelia micrantha
Peltophorum africanum
*_Psidium guajava_
Ficus capensis
Heteropyxis natalensis
Cussonia spicata
Catha edulis
Dovyalis zeyheri
Rhus chirindensis forma

Shrubs:

Rhoicissus tridentata
Flemingia grahamiana
Pseudarthria hookeri
Diospyros lycioides subsp.
Vernonia ampla
V. corymbosa
*_Cassia laevigata_
Lippia javanica
Canthium inerme
Grewia occidentalis
Pycnostachys urticifolia
Iboza riparia

Low Soft Shrubs, Undershrubs and Tall Subwoody Forbs and Ferns:

Leonotis dysophylla
Endostemon obtusifolius
Rhynchosia komatiensis
Indigofera schinzii
Hypoestes aristata
Nidorella auriculata
Pavonia columella
Athrixia phylicoides
Hermannia gerrardii
Indigofera swaziensis
Artemisia afra
Pteridium aquilinum
Schistostephium heptalobum

Low Forbs and Ferns:

Helichrysum nudifolium var.
Inula glomerata
Vernonia natalensis
Cyphia elata
Conostomium natalense var.
Triumfetta pilosa var. effusa
T. rhomboidea
Acalypha punctata
Gerbera glandulosa
G. jamesonii
Knowltonia transvaalensis
Kalanchoe rotundifolia
Eulophia streptopetala
Haemanthus magnificus
Pellaea viridis
Zantedeschia tropicalis

Inula glomerata, Triumfetta spp., Achyranthes aspera and other weedy species appear to have drifted in from an adjacent firebreak.

Grasses and Grass-like Plants:

Commelina diffusa
Schoenoxiphium sparteum
Hyparrhenia cymbaria
H. gazensis
Panicum maximum
Rhynchelytrum repens
Setaria chevalieri
S. sphacelata

Lianes and Scramblers:

Of the more robust climbing plants, Smilax kraussiana is the most frequent, accompanied by Secamone alpinii, Carissa edulis and Clematis brachiata.

Soft Twiners and Scramblers:

Dioscorea spp.
Rhynchosia caribaea
Cassytha ciliolata
Abrus fruticulosus
Stephania abyssinica
Rubia cordifolia
Thunbergia alata

The foregoing series, (a) to (e), represents a special situation in the development of an Acacia ataxacantha thicket, viz. that developed in a rain shadow in the High Scrub Forest Zone. Acacia ataxacantha scrub in its various forms is a typical xeroseral and subseral stage in both the Mistbelt and the Low Country. The A. ataxacantha scrub developed away from the rain shadow in this zone differs in some respects but the dominant and subdominant species correspond. As an example of the more mesophytic A. ataxacantha scrub developed in the High Scrub Forest Zone, the rather open scrub on the eastern aspect of Piesang Kop, also approaching the upper boundary of the High Scrub Forest Zone, is described.

(f) Mesoclinal Acacia ataxacantha Consocies. The community described below is considerably more open and less tangled although more mesophytic in facies than the community just described. It stands on a deeper accumulation of soil and probably receives a heavier rainfall than the previously described community. Being less of a thicket, a certain degree of stratification can be discerned as indicated in the following description. That this represents a relatively early stage in the succession from lithoseral grassveld can be seen in the abundance of grassveld relics in the field layer, e.g. Knowltonia transvaalensis, Gerbera kraussii, Aloe greatheadii, A. lettyae, Helichrysum undatum and Scilla glaucescens.

(i) Tree Layer. The trees form an open irregular canopy from 4 m to about 6 m in height. Acacia ataxacantha is the predominant species, accompanied by Euclea crispa, Cussonia spicata, Acacia davyi and Rhus rehmanniana.

(ii) "Understory". An understory of small trees or large shrubs, from about 2 m to 4 m tall, is beginning to develop. It includes Grewia occidentalis and Carissa bispinosa var. acuminata. These are outnumbered by transgressive small trees especially Acacia ataxacantha, Bridelia micrantha, Euclea crispa, Pittosporum viridiflorum, Maesa lanceolata, Acacia davyi, Brachylaena transvaalensis, Rhus intermedia, R. rehmannii, R. chirindensis forma legatii and Ziziphus mucronata.

(iii) Shrub Layer (about 1 m to 2 m in height). The more important shrubby plants include Diospyros lycioides subsp. sericea, Vernonia corymbosa, Rhynchosia clivorum, Vernonia ampla, Flemingia grahamiana and Pseudarthria hookeri, together with transgressive small trees and shrubs of the foregoing species.

(iv) Field Layer (up to about 1 m in height). This stratum can be conveniently and naturally subdivided into the following two sublayers:

Smaller Softer Shrubs, Undershrubs and Taller Subwoody Forbs and Ferns. This subclass includes Tephrosia shiluwanensis, Justicia cheiranthifolia, Nidorella auriculata, Athrixia phylicoides, Endostemon obtusifolius, Helichrysum odoratissimum, H. lepidissimum, Leonotis dysophylla, Pteridium aquilinum and Triumfetta rhomboidea. These more woody plants of the field layer are accompanied by numerous small saplings and seedlings of the above trees and shrubs.

Smaller and Softer Herbs and Ferns. The following are among the more abundant truly herbaceous elements of the field layer:

Setaria sphacelata	Hyparrhenia hirta
Eragrostis curvula	Paspalum commersonii
Knowltonia transvaalensis	Pellaea viridis
Helichrysum nudifolium var.	Phyllanthus nummulariaefolius
Rhynchelytrum repens	Aloe sp. (A. greatheadii? A. lettyae?)
Anthospermum herbaceum	Chaetacanthus setiger
Carex spicato-paniculata	Helichrysum undatum
Gerbera kraussii	Scilla glaucescens
	Tephrosia macropoda

(v) Lianoid Plants. The more important robust lianoid plants are Acacia ataxacantha, Cephalanthus natalensis, Clematis brachiata, Smilax kraussiana and Sphedamnocarpus galphimiifolius. Less robust lianoid plants are Rhynchosia caribaea, Cyphostemma cirrhosum subsp. transvaalense, C. woodii, Rhoicissus tridentata, Abrus fruticulosus, Adenia digitata, Asparagus africanus, Rubia cordifolia, Cissampelos torulosa, Stephania abyssinica and Trochomeria hookeri.

(vi) Hemiparasitic Plants. The most abundant hemi-parasite is the hemi-epiphytic twiner Cassytha ciliolata. Also present is the scrambling shrubby Osyridicarpos schimperianus, hemiparasitic on roots.

(1.3) Lithosere on Talus Slopes. Very little can be inferred concerning the succession on scree. The only community encountered on talus slopes was a woodland dominated by Drypetes gerrardii, representing a fairly advanced stage of succession and giving no reliable indications of any earlier seral communities.

Drypetes gerrardii Consocies. The single stand is very limited in extent, being confined to the north-facing (xeroclinal) talus slopes near to (east of) the waterfall at the head of the upper Mtataspruit kloof near the Rosendal-Grootbosch boundary (see p. 141) at about 1200 m elevation.

(a) Habitat. The stand is surrounded by open to closed scrub to the east; riverine, kloof and cliff forest to the west and north; and rather scrubby Melinis minutiflora var. inermis grassland to the south, above the brink of the free face. It is sheltered from most winds and exposed to morning and early afternoon sun throughout the year. The aspect is northerly and the slope steep, probably averaging between 25° and 30° from the horizontal. The substratum consists mainly of broken bedrock with more or less stabilised scree of variously quartziferous to gneissose granite-gneiss rocks and boulders with a small proportion of diabase. The depth of soil, where present, varies a great deal, with locally deep accumulations of humiferous soil. Apart from the heavy litter fall, the substratum is enriched by mammalian droppings possibly of "dassies"[1], dormice (*Graphiurus marinus* Desmarest subsp.) or squirrels, inhabiting nooks and crannies of the craggy free face or small "krans" above the talus slope.

The rainfall in this vicinity is probably fairly heavy, the mean annual precipitation being, perhaps, of the order of 1500 mm, but the effectiveness of the rainfall is locally reduced and varies from place to place and from plant to plant (see *Ecological Notes* below).

(b) *Structure and Composition.* The canopy is more or less closed but uneven, with the trees rather widely and irregularly spaced. Stratification is poorly developed and only the canopy and understory are distinct. The following synusiae are, nevertheless, present:

(i) *Canopy.* Canopy trees reach heights of about 15 m in places. *Drypetes gerrardii* is dominant accompanied by such trees as *Celtis africana*, *Allophylus transvaalensis*, *Maytenus peduncularis*, *Nuxia floribunda*, *Ochna holstii*, *O. o'connorii*, *Strychnos mitis* and *Vangueria infausta* with isolated *Olea capensis* subsp. *macrocarpa*.

(ii) *Understory.* The understory is composed largely of small trees of *Ochna o'connorii*, *Teclea natalensis*, *Rawsonia lucida*, *Drypetes gerrardii*, *Ochna holstii*, *Rinorea angustifolia*, *Strychnos mitis*, *Vangueria infausta*, *Dombeya burgessiae*, *Cussonia spicata* and *Trichilia dregeana*.

(iii) *Shrub Layer.* This stratum is very discontinuous and poorly represented on the whole, consisting largely of scattered *Sclerochiton harveyanus*, *Plectranthus fruticosus*, and *Justicia campylostemon*. These shrubs tend to be more concentrated on the lower slopes where the scree is more stabilised.

(iv) *Field Layer.* This can conveniently be regarded as one entity which is, however, discontinuous and poorly developed, on the whole, being restricted to shallow to deep accumulations of litter and duff[2] on and between the boulders and rocks. This habitat is not only rather unstable but also subject to periodic severe desiccation scarcely offset by the shade and infrequent mists.

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1 *Dendrohyrax arboreus* A. Smith, or *D. brucei granti* Wroughton or both, or perhaps *Procavia capensis* Pallas.

2 In this account, "duff" denotes decomposed and partly decomposed organic matter, i.e. both humus and leaf mould.

The more abundant species are Asplenium aethiopicum, A. splendens, Chlorophytum comosum, Clivia caulescens, Hypoestes verticillaris, and occasional Crocosmia aurea, with isolated Asplenium rutaefolium, Begonia sonderiana, Dietes vegeta, Doryopteris concolor var. kirkii, Eulophia streptopetala, Kalanchoe rotundifolia, Peperomia retusa and Streptocarpus parviflorus.

(v) Lianoid Plants.

Lianes and Scramblers. Great lengths of tangled, looped and trailing liana stems lie scattered about on the substratum at intervals. The more robust woody and subwoody lianoid plants capable of reaching the canopy vary from more or less abundant to rather infrequent. These include Hippocratea nitida, Rhoicissus revoilii, R. rhomboidea, Jasminum streptopus var. transvaalense, Rhoicissus tomentosa, Secamone gerrardii, Adenia gummifera, Canthium gueinzii, Cryptolepis capensis, Cyphostemma anatomicum, Mikania cordata, Entada spicata and isolated large Riocreuxia torulosa.

Soft Twiners. The poorly represented and less conspicuous, less robust lianoid plants include Solanum bifurcum, Behnia reticulata, Senecio deltoideus and S. tamoides, with occasional Asparagus plumosus and Riocreuxia torulosa.

(vi) Epiphytes. Epiphytic plants are relatively rare for the most part, probably largely owing to the smoothness of the bark and the deep shade cast by the dominant - a densely leafy evergreen tree. Myxomycetes creeping over the bark may be fairly common at times and may be a factor contributing to the inhospitability of the bark as a substratum but this seems doubtful. Neckeraceous mosses, especially species of Pilotrichella may be locally common but vascular epiphytes are rare, e.g. Mystacidium sp.

(c) Ecological Notes. The canopy trees are predominantly evergreen, except for Celtis africana and Vangueria infausta. The lower boles of Drypetes gerrardii are strongly buttressed and fluted and frequently bear aerial roots the lower of which may become prop roots.

It is evident that this community is composed of species which are able to accommodate themselves to the peculiar conditions of the habitat. Climatically, the situation is fairly favourable. The site enjoys a mild to warm frost-free climate. It is periodically misty, sheltered from cold and dry winds and the vicinity receives a fairly heavy rainfall.

Owing to the steep slope, precipitation per unit area "soil" surface is low relative to precipitation on the horizontal. This reduced effectiveness of rainfall is aggravated for the more shallow-rooted plants by canopy interception, and rapid penetration into the mantle of debris and drainage away from the surface. Once the more deeply rooted trees and lianes are well established, for them the percolating water, remaining available for longer periods and augmented by water derived from upslope run-off and subsurface drainage, compensates for the rapid surface drainage and less favourable site factors. Moreover, for those deep-rooted species able to reach it, presumably adequate and more or less permanent ground-water is available at depth. These compensatory factors apparently enable the well-adapted canopy components to exploit the resources of the habitat to the full, in view of their growing in an effectively dry xeroclinal situation, where the canopy is fully exposed to the sun.

Owing to the slowness of weathering of parent rock, soil formation and stabilisation must necessarily take place largely through the accumulation of organic matter. Should the habitat become more stabilised and greater quantities of soil be built up, it is possible that such species as _Celtis africana_, _Nuxia floribunda_, _N. congesta_, _Trichilia dregeana_, _Cussonia spicata_, _Cryptocarya liebertiana_, _Fagara davyi_, _Mimusops zeyheri_ and _Scolopia zeyheri_ will gradually become established in increasing numbers and convert the _D. gerrardii_ Consocies into a more mixed community. _Drypetes gerrardii_ and _Strychnos mitis_ appear to be among the few trees really well adapted to the conditions imposed by the tumbled rocks and boulders, however, and they are likely to persist for the foreseeable future.

(2) Intermediate Stages of Xerosere. Apart from the lithoseral communities just described and, possibly, a few fragmentary patches, very little seral vegetation is to be seen in a natural state in the High Scrub Forest Zone. Besides postclimax vegetation and areas at present under cultivation and timber plantations, the vegetation on deeper soil is largely a patchwork of secondary communities at various stages of development. So confused is the picture that it is not possible to provide a stage-by-stage account of the succession to climax high scrub forest. The trend would seem to be towards the thickening up of increasingly rank and scrubby grassveld by way of invasion by various shrubs, trees and lianoid plants, after the fashion of the lithoseres so far described, to form scrub communities in which taller and more mesophytic species would increase, eventually to give rise to scrub forest. The earlier seral stages of this zone resemble the Low Country vegetation in many respects but the later stages tend to resemble the seral stages of the adjacent Lower High Forest Zone more and more as the succession progresses.

Some of the more characteristic components of the seral grassveld and scrubby vegetation types are listed below, in a rough approximation of the order of their appearance in the sere. The presence of several of these species can sometimes be considered to indicate, or, at least, suggest the prevalence of Mistbelt conditions where a number of them occur away from water and sheltered kloofs. Some of these species whose occurrence in quantity, away from water and kloofs, is regarded as particularly significant are indicated by the letter "A" in parentheses. Species that tend to be found only in the upper levels of the High Scrub Forest Zone away from the lower Mistbelt ecotone, are indicated by an upward-pointing arrow. Species that are especially numerous or typical of this zone are followed by an asterisk, or two asterisks where particularly abundant and characteristic.

(a) Ground Layer. A ground layer is rarely seen except on bare patches. In such places, a well-represented moss flora can suggest Mistbelt conditions, e.g. species of *Bryum*, *Ditrichum*, *Entodon*, *Pogonatum*, *Polytrichum*, *Ptychomitrium*, *Rhacopilum*, *Schlotheimia* and *Tortella*.

(b) Herbaceous Plants. The "field layer" is conveniently considered if subdivided into three subclasses, as follows:

(i) Grasses and Grass-like Plants. This subclass includes the following species:

Eragrostis curvula
E. racemosa
Loudetia simplex
Sporobolus pyramidalis
Hyparrhenia cymbaria
H. gazensis
H. hirta
Melinis minutiflora var. (A)
Panicum maximum
Paspalum commersonii
Rhynchelytrum repens
Schizachyrium semiberbe
Schoenoxiphium sparteum
Setaria chevalieri
S. flabellata
S. sphacelata
Carex spicato-paniculata
Cymbopogon validus
Cyperus albostriatus
Eragrostis capensis
Kniphofia splendida ?
Moraea sp., cf. *M. spathulata*
Oplismenus hirtellus (undergrowth)
Panicum hymeniochilum var.

(ii) Low Forbs and Pteridophytes. The following are among the more typical smaller forbs, ferns and fern-allies likely to be encountered in scrubby vegetation from grassveld to scrub forest:

Acalypha punctata
A. schinzii *
A. wilmsii (rare)
Aloe greatheadii
A. lettyae
Anthospermum herbaceum
Clutia monticola
Crassula rubicunda (shallow soil)
Fadogia monticola
Gerbera kraussii
Helichrysum acutatum
H. nudifolium var.
Helichrysum adscendens
H. umbraculigerum
Knowltonia transvaalensis
Lycopodium clavatum
Mohria caffrorum
Pentanisia prunelloides
Pimpinella transvaalensis
Alepidea gracilis var. (A)
Cineraria fruticetorum
Galopina circaeoides (undergrowth)
Hypoestes verticillaris (undergrowth)
Littonia modesta (sometimes sub-[scandent)

(iii) Taller Subwoody and Shrubby Forbs and Ferns.[1] Some characteristic suffrutescent forbs and ferns which tend to increase in the later stages of succession are the following:

Hebenstreitia comosa
Helichrysum lepidissimum
H. odoratissimum
H. setosum formae
Hemizygia rehmannii (especial-[ly rocky places)
Hermannia floribunda
Hypoestes aristata
Justicia cheiranthifolia forma
Pavonia columella
Peucedanum venosum
Polygala virgata
Pseudarthria hookeri
Pteridium aquilinum
Schistostephium heptalobum
Selago elata
Senecio isatideoides
S. pandurifolius
Sparmannia ricinocarpa
Stachys nigricans
Sutera floribunda
Thunbergia natalensis
Argyrolobium tomentosum
Asparagus saundersiae (later lianoid)
A. virgatus (undergrowth)
Aster peglerae
Athanasia punctata *
Clutia affinis (A)
Phaulopsis imbricata (undergrowth)
Pouzolzia parasitica (A) (undergrowth)

Phaulopsis imbricata increases locally to become abundant to dominant

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1 Several of these could be regarded as shrubs when fully grown but they are usually smaller.

in the field layer as the tree crowns begin to form a canopy.

(c) Shrubs. The more conspicuous shrubby plants, including subscandent shrubs, participating in the thickening up from grassveld to scrub forest, are included in the following list:

Canthium huillense (small)
C. inerme (small)
Carissa bispinosa var.
Cassia petersiana (small)
Cephalanthus natalensis (later subscandent)
Choristylis rhamnoides (later subscandent)
Clausena anisata (small) (A)
Conyza ivaefolia (A)
Flemingia grahamiana
Greuia occidentalis (later subscandent)
Hibiscus altissimus (later subscandent)
Maytenus mossambicensis var. (A; occasional ↑)
Rhamnus prinoides (later subscandent)
Rhoicissus tridentata (later subscandent)
Rhynchosia clivorum
Rubus sp.
R. pinnatus (later subscandent)
Sutera accrescens
Tephrosia zombensis
Vernonia ampla
V. corymbosa
V. shirensis

(d) Trees. Perhaps the most significant indicator of Mistbelt conditions is the occurrence of the typical tall Mistbelt form of Cussonia spicata with glabrous dark green foliage and relatively thin light-coloured bark. The following species invade earlier seral stages and thicken up into scrub and eventually scrub forest, if not disturbed:

Acacia ataxacantha **
A. davyi **
A. sieberiana var.
Anthocleista grandiflora (occasional)
Antidesma venosum
Brachylaena transvaalensis *
Bridelia micrantha *
Canthium huillense (fully grown)
C. inerme (fully grown)
Cassia petersiana (fully grown)
Catha edulis *(localised, gregarious)
Combretum erythrophyllum
C. gueinzii **
Dombeya burgessiae
D. rotundifolia
Dovyalis zeyheri
Erythrina lysistemon (occasional)
E. latissima (rare)
Euclea crispa **
Faurea saligna
F. speciosa *
Ficus capensis
Grewia occidentalis (fully grown)
Heteromorpha trifoliata
Heteropyxis natalensis
Maesa lanceolata* (A)
Maytenus heterophylla
Nuxia congesta **
N. floribunda *(A; occasional; locally abundant)
Parinari curatellifolia subsp.**
Pavetta barbertonensis (A; occasional)
Protea rhodantha (occasional, ↑)
Rauvolfia caffra (A)
Rhamnus prinoides (fully grown, sometimes subscandent)
Rhus intermedia
R. chirindensis forma ↑
R. rehmanniana *
Scolopia zeyheri (rocky places)
Strelitzia caudata (occasional, ↑)
Syzygium cordatum * (A)
Trema orientalis
Trimeria grandifolia (A)
Allophylus transvaalensis (A)
Bersama sp., cf. B. transvaalensis (occasional)
Celtis africana
Clausena anisata (fully grown; A)
Combretum kraussii (A)
Cussonia spicata (A)
Dais cotinifolia (occasional; ↑)
Ekebergia capensis (occasional)
Maytenus peduncularis (occasional)
Ochna holstii (A)
Pittosporum viridiflorum

(e) Lianoid Plants. The growth forms of some of the lianoid plants vary with age and habitat from a more or less erect and shrubby to a scrambling habit as succession proceeds and the scrubby communities thicken up. Such facultative lianoid plants are Acacia ataxacantha, Asparagus saundersiae, Cephalanthus natalensis, Choristylis rhamnoides, Grewia occidentalis, Hibiscus altissimus, Littonia modesta, Rhamnus prinoides, Rubus sp., Rubus pinnatus and Senecio deltoideus. For the most part, the lianoid plants are usually fairly clearly differentiated into the larger, woody, more robust lianes and scramblers, and the softer slender forms, although Jasminum streptopus var. transvaalense, Riocreuxia torulosa and Smilax kraussiana can be considered to be intermediate in habit.

(i) More Robust Lianoid Plants. The more robust lianoid plants include Acacia ataxacantha*, Cephalanthus natalensis*, Choristylis rhamnoides*, Clematis brachiata, Cnestis natalensis (rather rare), Grewia occidentalis*, Helinus integrifolius*, Hibiscus altissimus, Jasminum streptopus var. transvaalense*, Mikania cordata*(A), Riocreuxia torulosa*, Rubus sp. (A,↑), Rubus pinnatus, Secamone alpinii (A), S. gerrardii (A), Smilax kraussiana* and Sphedamnocarpus galphimiifolius.

(ii) Less Robust Lianoid Plants. Amongst the more typical slender climbers and scramblers are Asparagus asparagoides*, Cyphia transvaalensis*, Dioscorea cotinifolia, D. retusa (A), Ipomoea wightii, Jasminum streptopus var. transvaalense*, Littonia modesta*, Riocreuxia torulosa*, Senecio deltoideus (A) and Smilax kraussiana*.

(f) Epiphytes. A greater or lesser abundance of epiphytic plants away from damp kloofs and streams provides evidence for more or less typical Mistbelt conditions respectively. Particularly noteworthy in this respect are certain fruticose lichens, e.g. species of Anaptychia, Ramalina, Teloschistes and Usnea. The epiphytic moss flora may also indicate the frequent presence of mist and a fairly heavy rainfall, e.g. species of Entodon and Schlotheimia. Vascular epiphytes are much less common but Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii, Peperomia reflexa and P. retusa, with occasional Polystachya sp., aff. P. zambesiaca and scattered colonies of P. ottoniana do occur sporadically away from the river-valleys. Close to streams, vascular epiphytes, e.g. Polystachya imbricata as well as the above-named species, are conspicuously common.

(g) Parasites and Hemiparasites. A very characteristic plant of the scrubby vegetation seral to scrub forest is the hemi-epiphytic hemiparasitic twiner Cassytha ciliolata. The shrubby to subscandent

Osyridicarpos schimperianus is hemiparasitic on roots. Holoparasitic on roots are the more widespread Harveya coccinea and, far less commonly, H. speciosa, which is more restricted to the High Scrub Forest Zone, especially the rank scrubby sour grassveld stages.

2. THE CLIMAX

The hypothetical climatic climax in the High Scrub Forest Zone would appear to be some kind of scrub forest probably rather taller and more mesophytic than that presumed to be climax of the Low Scrub Forest Zone. No such climax high scrub forest appears to be represented in this zone on Westfalia Estate, although some indications of its probable composition are furnished by parts of the seral scrub where it is thickening up. Some typical species associated with this thickening up of seral scrub to scrub forest are set out below. The symbols appearing behind the plant names have the same significances as in the preceding discussion of seral vegetation.

2.1 STRUCTURE AND COMPOSITION

A more or less closed canopy can probably develop but this may well be irregular in height with poor differentiation between canopy and understory trees. The following synusiae are likely to be represented:

(A) TREES

Although well-differentiated overstory, canopy and understory strata are unlikely to develop, trees which would probably tend to be lower than the general level of the canopy and locally to contribute towards the formation of a discontinuous understory are indicated by the letter "U" in parentheses:

Brachylaena transvaalensis *
Bridelia micrantha
Canthium inerme (U)
Combretum kraussii *↑(A)
Cussonia spicata *↑(A)
Erythrina lysistemon
Euclea crispa **
Ficus capensis
Maesa lanceolata (U)
Nuxia congesta *
N. floribunda *(A, ↑)
Parinari curatellifolia subsp.
Pittosporum viridiflorum
Rauvolfia caffra (A)
Rhus chirindensis forma *↑
Syzygium cordatum **(A)
Trimeria grandifolia (U)
Allophylus transvaalensis (U,A,↑)
Acacia sieberiana var.
(occasional)
Anthocleista grandiflora
(occasional)

Aphloia theiformis *↑(U,A)(occasional)
Apodytes dimidiata *(A)↑ "
Bersama sp., cf. *B. transvaalensis* *↑
(U,A)(occasional)
Catha edulis (as relics)(occasional)
Clausena anisata *(fully grown, U,A)↑
(occasional)
Combretum gueinzii (occasional)
Dombeya burgessiae (U) "
Dovyalis zeyheri "
Eugenia natalitia ↑(fully grown, U,A)
(occasional)
Faurea speciosa (as relics)(occasional)
Heteromorpha trifoliata " "
Heteropyxis natalensis " "
Maytenus heterophylla " "
M. peduncularis (A,↑) "
Mimusops zeyheri "
Ochna holstii (U) "
Prunus africana "
Rhus rehmanniana (as relics) "
Scolopia zeyheri "
Trema orientalis (as relics) "

These trees increase at the expense of the typical early stage scrub or seral low scrub forest species of trees and shrubs such as *Acacia davyi*, *Antidesma venosum*, *Canthium huillense*, *Cassia petersiana* and others. Simultaneously, facultative lianoid trees and shrubs may persist as canopy components after assuming the scrambling habit, e.g. *Acacia ataxacantha*, *Cephalanthus natalensis* and *Choristylis rhamnoides*. Of the above arborescent species, *Aphloia theiformis* may also adopt a subscandent mode of growth on occasion.

(B) SHRUB LAYER

This "stratum" may not only be discontinuous but also poorly represented in shrubs proper, as opposed to potentially taller elements, e.g. *Clausena anisata*. Besides many other transgressive small trees, the most abundant species are likely to be small *Canthium inerme* and *Carissa bispinosa* var. *acuminata*, with occasional transgressive *Clausena anisata*, *Eugenia natalitia* and *Maytenus mossambicensis* var. *mossambicensis*, together with small, more or less erect to subscandent *Grewia occidentalis*, *Choristylis rhamnoides*, *Cephalanthus natalensis* and *Rhamnus prinoides*.

(C) FIELD LAYER

Surmising that stratification within the field layer will be no more conspicuously developed than in the climax community as a whole the field layer is regarded as one entity. Field-layer components are likely to include the following species:

Anthospermum herbaceum
Argyrolobium tomentosum
Asparagus saundersiae
A. virgatus
Aster peglerae (relic?)
Carex spicato-paniculata
Cyperus albostriatus
Desmodium repandum
Dietes vegeta
Ehrharta erecta
Galopina circaeoides
Hypoestes verticillaris
Oplismenus hirtellus
Panicum hymeniochilum var.
P. monticolum
Paspalum commersonii
Phaulopsis imbricata
Pouzolzia parasitica
Pteridium aquilinum (large-fronded relic)
Pteris catoptera
Setaria chevalieri
S. sphacelata
Sparmannia ricinocarpa
Sutera floribunda
Thunbergia natalensis

(D) GROUND LAYER

Except for locally luxuriant colonies of mosses, e.g. Entodon spp., on steep-sided rocks and boulders, a ground layer will probably be suppressed by heavy litter fall.

(E) LIANOID PLANTS

Lianoid plants will probably contribute a great deal to the formation of a canopy, serving to knit it together although such a canopy is likely to be irregular in height and, perhaps, locally discontinuous. Although contribution to the canopy cannot usefully serve as a criterion, the lianoid plants, except for say Jasminum streptopus var. transvaalense, Riocreuxia torulosa and Smilax kraussiana, can be naturally subdivided on the basis of size and woodiness into the following two more or less distinct synusiae:

(1) Lianes and Scramblers. The more robust lianoid plants are likely to include the following species:

Acacia ataxacantha
Adenia gummifera
Cephalanthus natalensis
Choristylis rhamnoides
Clematis brachiata
Cnestis natalensis
Grewia occidentalis
Helinus integrifolius
Jasminum streptopus var.
Mikania cordata
Rhoicissus rhomboidea
R. tomentosa
Riocreuxia torulosa
Rubus pinnatus
Secamone alpinii
S. gerrardii
Smilax kraussiana
Sphedamnocarpus galphimiifolius
Canthium gueinzii occasional
Entada spicata " ?

(2) Slender Softer Climbers. Less robust lianoid plants are likely to include Asparagus asparagoides*, A. plumosus, Cyphia transvaalensis*, Dioscorea cotinifolia, D. retusa (A), Dumasia villosa, Ipomoea wightii, Jasminum streptopus var, transvaalense, Riocreuxia torulosa, Senecio deltoideus and Smilax kraussiana.

Plate 18. Lower margin of *Ficus capensis*-Other Species Associes, seen in profile where it abuts on a recently clear-felled eucalypt plantation. The pale-stemmed leafless trees at left are *Ficus capensis*.

(F) EPIPHYTES

Epiphytic plants are often present in the more mature stands especially those on mesoclinal sites more subject to misty conditions. Fruticose lichens, e.g. species of Anaptychia, Ramalina, Teloschistes and Usnea, may well continue to be conspicuous in the upper crowns in suitable spots while foliose lichenes and bryophytes grow lower down on the stems. Epiphytic ferns will almost certainly include Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and occasional species of Asplenium e.g. A. aethiopicum and A. rutaefolium. Other vascular epiphytes likely to be present are Peperomia reflexa, P. retusa and Polystachya ottoniana. Vascular epiphytes normally reach their best development in gallery forest along the streams (see p. 138 et seq.).

(G) PARASITES

Parasites and hemiparasites will probably only be sparingly represented mainly by hemi-epiphytic hemiparasites, viz. the twining Cassytha ciliolata and perhaps the bushy Loranthus dregei. Root parasites such as the hemiparasitic shrubby to scrambling Osyridicarpos schimperianus and the holoparasitic herb Harveya coccinea may also occur sporadically.

3. POSTCLIMAXES

(A) FICUS CAPENSIS - OTHER SPECIES ASSOCIES

This community is found along the length of the lower portion of a non-perennial watercourse on the lower northwestern slopes of Piesang Kop, on the southwestern portion of Christinasrust, at about 1250 m elevation.

(1) Habitat. The watercourse, lying in a small kloof running roughly from south to north, is exposed to the sun for most of the day but fairly sheltered against wind except, to some extent, northerly winds. The gradient varies from steep in the upper reaches to moderate or slight below. The rather extreme xeroclinal conditions are offset by favourable edaphic and ecoclimatic conditions (see Plate 18).

(2) Structure and Composition. The canopy is irregular in height but more or less closed with small gaps becoming larger and more frequent upwards. The trees are irregularly spaced with irregularly spreading crowns. Stratification is not markedly developed although several synusiae can be discerned. In the description to follow, names followed

by upward- and downward-pointing arrow signs indicate that the species concerned are more commonly found in the upper and the lower reaches of the kloof respectively.

(a) Overstory. Emergents are almost absent except for very occasional exceptionally big trees of *Ficus capensis*.

(b) Canopy. The canopy is irregular in height but more or less closed in the lower portion where it consists largely of *Ficus capensis* associated with the following species:

Brachylaena transvaalensis	*Allophylus transvaalensis*
Euclea crispa	*Combretum gueinzii*
* *Psidium guajava*	*C. kraussii*
Dovyalis zeyheri	*Dombeya burgessiae*
Maesa lanceolata	*Nuxia floribunda*
Scolopia zeyheri	*Syzygium cordatum*
Trema orientalis	*Cussonia spicata*
Acacia davyi	*Ficus craterostoma*? *F. petersii*?
	Trichilia dregeana? (*T. emetica*?)

The canopy becomes more open upwards and *Acacia ataxacantha* and *Euclea crispa* become more abundant and assume dominance with *Brachylaena transvaalensis* and *Cussonia spicata*, while *Ficus capensis* becomes less important.

(c) Understory (about 2.5 m to about 5 m in height). The understory is poorly developed with few understory trees proper. The most notable of these are *Eugenia natalitia* and *Grewia occidentalis* (more or less lianoid) with occasional *Canthium huillense* and *Trimeria grandifolia*. Among the more abundant potentially taller trees present in this stratum are *Scolopia zeyheri*, *Bersama* sp., cf. *B. transvaalensis*, *Pittosporum viridiflorum*, *Allophylus transvaalensis* and *Euclea crispa*, with *Acacia ataxacantha* (more or less lianoid), *Heteromorpha trifoliata*, *Syzygium cordatum* and *Xymalos monospora*.

(d) Shrub Layer (about 1 m to about 2 m tall). This stratum is poorly represented in fully grown shrubs such as *Vernonia ampla* and *V. corymbosa*, which grow in the more open places. Numerous undersized shrubs and transgressive trees are also present. These include *Euclea crispa*, *Canthium huillense*, *Bersama* sp., cf. *B. transvaalensis*, *Canthium inerme*, *Scolopia zeyheri*, *Eugenia natalitia*, *Allophylus transvaalensis*, *Maytenus heterophylla*, *Rhus intermedia* and *Trema orientalis*, with occasional *Dovyalis zeyheri*, *Dombeya burgessiae*, *Maytenus mossambicensis* var. *mossambicensis*, *Pittosporum viridiflorum* and *Syzygium cordatum*.

(e) Field Layer (up to about 1.5 m maximum height). Field-layer components can be segregated into two sublayers, mainly on the basis of height, as follows:

(i) Low Soft Shrubs, Undershrubs and Tall Herbs (from about 0.5 m to about 1.5 m tall, at maximum height; e.g. Setaria chevalieri, *Cassia laevigata, Endostemon obtusifolius, Panicum maximum, Leonotis dysophylla, Rhoicissus tridentata and Lippia javanica). Codominant in this subclass are Setaria chevalieri and Desmodium repandum with Asparagus virgatus subdominant. Associated species include Hypoestes aristata, Carex spicato-paniculata, Plectranthus laxiflorus, Flemingia grahamiana, Hyparrhenia cymbaria, Schistostephium heptalobum, Sparmannia ricinocarpa, Argyrolobium tomentosum, *Cassia laevigata, Endostemon obtusifolius, Justicia cheiranthifolia, Panicum maximum, Leonotis dysophylla, Rhoicissus tridentata, Indigofera schinzii, Lippia javanica and Nidorella auriculata.

(ii) Low Herbs and Ferns (up to about 0.5 m tall). This sublayer is poorly developed on the whole, consisting of Pellaea viridis, Cyperus albostriatus, Oplismenus hirtellus, Dryopteris inaequalis, Haemanthus magnificus, Achyranthes aspera, Galopina circaeoides, Lapeirousia grandiflora, Triumfetta pilosa var. effusa and T. rhomboidea, with occasional Littonia modesta (subscandent) and Zantedeschia tropicalis. Occasional Kalanchoe rotundifolia and Pleopeltis macrocarpa grow on rocks in the bed of the watercourse.

(f) Ground Layer. This layer is poorly developed consisting mainly of mosses on rocks in the bed of the watercourse, with a few mosses on humus soil away from the bed.

(g) Lianoid Plants. Scandent and subscandent plants are considered to comprise two synusiae as set out below:

(i) Lianes and Scramblers. The more robust lianoid plants are normally capable of reaching and contributing to the canopy (Acacia ataxacantha has already been mentioned as an arborescent canopy component in the upper portion). The more abundant species include Rhoicissus tomentosa, Smilax kraussiana, Clematis brachiata , Sphedamnocarpus galphimiifolius, Cephalanthus natalensis, Adenia gummifera and Canthium gueinzii, with occasional Acacia ataxacantha , Asparagus falcatus, lianoid Combretum gueinzii, lianoid Maesa lanceolata, *Passiflora edulis, Rubus pinnatus and Vernonia mespilifolia.

(ii) Softer Slender Climbers. The less robust climbers are not normally capable of reaching the canopy. Of these, the more abundant species are *Ipomoea wightii*, *Rhynchosia caribaea*, *Riocreuxia torulosa*, *Glycine javanica* , *Solanum bifurcum* , *Asparagus asparagoides* , *Cissampelos torulosa*, *Thunbergia alata* , *Abrus fruticulosus*, *Adenia digitata* and *Dioscorea retusa*, with occasional *Jasminum streptopus* var. *transvaalense*. On account of its semi-erect habit and small size, *Littonia modesta* has been classified under the field-layer synusia.

(h) Hemi-Epiphytic Stranglers. One or two species of *Ficus* (*F. petersii* or *F. craterostoma* or both) which normally start life as epiphytes but which eventually contribute to the canopy are infrequent components.

(i) Epiphytes. Except for epiphytic lichens in the crowns of the more rough-barked trees, especially higher upslope, very few epiphytes appear to occur. Vascular epiphytes include *Polypodium polypodioides* subsp. *ecklonii*, with occasional *Peperomia reflexa*, *Pleopeltis macrocarpa* and *Polystachya ottoniana*.

(3) Ecological Notes. The canopy can be regarded as being partly, perhaps predominantly, semideciduous and partly evergreen. Succession does not appear to have run its full course and it seems likely that a more evergreen canopy could develop, with resultant changes in the undergrowth. The indications are that, if protected from disturbance, this community would develop into an association consisting, inter alia, of the following more woody species:

Canopy (and Overstory) Trees:

Scolopia zeyheri
Ficus capensis
Bersama sp., cf. *B. transvaalensis*
Brachylaena transvaalensis
Pittosporum viridiflorum
Trema orientalis (especially towards margins)
Dovyalis zeyheri
Combretum gueinzii
Syzygium cordatum
Combretum kraussii
Cussonia spicata
Ficus petersii? *F. craterostoma*?
Nuxia congesta
N. floribunda
Prunus africana
Trichilia dregeana? (*T. emetica*?)
Xymalos monospora
Anthocleista grandiflora?

Understory Trees:

Allophylus transvaalensis
Euclea crispa
Canthium inerme
Eugenia natalitia
Grewia occidentalis
Maesa lanceolata
Canthium huillense (towards margins)
Dombeya burgessiae
Maytenus heterophylla (towards margins)
Psidium guajava
Rhus intermedia (margins)
Trimeria grandifolia
Acacia davyi (margins)
Clerodendrum glabrum
Halleria lucida
Heteromorpha trifoliata
Maytenus mossambicensis var.
Xymalos monospora

Shrubs and Undershrubs:

Argyrolobium tomentosum, Sparmannia ricinocarpa and many more.

Lianoid Plants:

Acacia ataxacantha, Rhoicissus tomentosa, Smilax kraussiana, Sphedamnocarpus galphimiifolius and many others.

(B) MAYTENUS PEDUNCULARIS CONSOCIES

(1) Habitat. This community is restricted to a jumbled pile of rocks and boulders south of the Mtataspruit near where a trickle enters the stream from the south. It lies upstream of the Nokeng-e-Chweu dam in Rosendal, between about 1075 m and 1100 m elevation, i.e. near the lower edge of the Mistbelt.

(2) Structure and Composition. The stand described here has a closed canopy. Apart from the canopy and field layer, strata are poorly differentiated although several synusiae are represented.

(a) Canopy. Although more or less closed, the canopy has an irregular upper surface, varying from about 10 m to 15 m in height. The component trees are irregularly and rather widely spaced. A true overstory is not developed. Tall trees of Ficus capensis, Maytenus peduncularis, Pittosporum viridiflorum and Rhus chirindensis forma legatii do not really emerge from the canopy and are rather to be considered part of it. The canopy is clearly dominated by Maytenus peduncularis with Pittosporum viridiflorum subdominant, associated with Rhus chirindensis forma legatii and Ficus capensis. Maytenus peduncularis and R. chirindensis forma legatii and, to a lesser extent, F. capensis are mostly rather small.

(b) Understory. Except for transgressive Maytenus peduncularis and occasional large specimens of the shrubby M. mossambicensis var. mossambicensis, an understory is not developed.

(c) Shrub Layer. This stratum is poorly developed, consisting largely of Sclerochiton harveyanus with Plectranthus fruticosus and solitary Iboza riparia.

(d) Field Layer.

(i) Low Soft Shrubs, Undershrubs and Tall Subwoody Herbs and Ferns. This height class is poorly represented, consisting of a few scattered specimens of Coleus rehmannii, Desmodium repandum, Pouzolzia parasitica and Dryopteris inaequalis.

(ii) Low Herbs and Ferns. This sublayer and the field layer, as a whole, are overwhelmingly dominated by Clivia caulescens with Peperomia retusa subdominant on the boulders and rocks which make up the substratum. They are accompanied by several other saxicolous herbs and ferns as well as less specialised plants. Associated low herbs and ferns include Asplenium aethiopicum, Liparis neglecta, Oplismenus hirtellus, Pellaea viridis, Asplenium rutaefolium, Begonia sonderiana, Aneilema aequinoctiale, Cyperus albostriatus, Polypodium polypodioides subsp. ecklonii, with occasional Doryopteris concolor var. kirkii and Setaria chevalieri.

(e) Ground Layer. This is very well developed, extensive areas of the boulders and rocks being covered by mosses, e.g. Entodon brevirameus, Rhacopilum capense and Haplocladium angustifolium, and some lichens, notably species of Parmelia.

(f) Lianoid Plants. Of the larger and more woody lianoid plants capable of reaching the canopy, the most abundant species are Rhoicissus rhomboidea and Canthium gueinzii, accompanied by Rhoicissus tomentosa, Asparagus falcatus, Cyphostemma anatomicum, Acacia ataxacantha, Smilax kraussiana and occasional Cnestis natalensis.

The most abundant species among the less robust climbers is Solanum bifurcum, accompanied by Dioscorea cotinifolia, Senecio tamoides, Coccinia variifolia and Melothria punctata.

(g) Epiphytes. Epiphytic plants are rare. A few specimens of Peperomia retusa and occasional Clivia caulescens grow epiphytically here and there.

(3) Ecological Notes. The canopy is predominantly evergreen. The predominant field-layer herb Clivia caulescens is facultatively epiphytic, together with Peperomia retusa, Asplenium aethiopicum, Polypodium polypodioides subsp. ecklonii and A. rutaefolium. This suggests that the present field layer may, to some extent, be derived from the epiphytic flora of this community and the adjacent Syzygium cordatum Consociation (see p. 139). The field layer is predominantly evergreen but dying down of stems of Coleus rehmannii and, occasionally, of Desmodium repandum and Pouzolzia parasitica may occur in dry seasons.

The poverty of species in the field layer is evidently due to the peculiar nature of the substratum, viz. variously shallow to deep accumulations of litter and duff on and between the rocks and boulders. Only species adapted to an epiphytic or saxicolous mode of existence would be able to thrive in the shallow accumulations of organic matter on the rocks that form the greater portion of the substratum. It must be remembered that this community is situated in the lower levels of the Mistbelt where mist is relatively infrequent and the field layer components must be able to withstand periodic desiccation.

For canopy components, conditions are more favourable. Excellent infiltration, with probably negligible run-off,after heavy downpours results in effective replenishment and storage of ground-water. Light falls of rain are probably largely intercepted by the foliage of the canopy and undergrowth and the rock surfaces.

The stand appears to be very stable on the whole. As far as the dominant trees are concerned, it is quite possible that the stand may gradually change into a more mixed association, with the increase of such species as Pittosporum viridiflorum, Ficus capensis, Bridelia micrantha and Combretum kraussii, with attendant increase in the understory of Clausena anisata, Allophylus transvaalensis and others. Notwithstanding these possible changes, the very slow rate of accumulation of litter and duff and the extremely slow weathering of the tumbled rocks, the most uncompromising feature of the habitat, make for a very slow soil-formation process. Any fundamental change in the composition and structure of the community, including the subordinate layers, must of necessity take place only very gradually.

(C) SYZYGIUM CORDATUM CONSOCIATION

(1) Habitat. The gallery forest stand on which this description is based is located along a length of the Mtataspruit upstream of the Nokeng-e-Chweu Dam in Rosendal, a short distance to the north and northwest of the *Maytenus peduncularis* Consocies just described. The elevation varies from about 1075 m to about 1100 m.

(2) Structure and Composition. The facies is dominated by large trees fairly regularly distributed along the stream banks but occasionally aggregated into small clumps. Stratification is moderately developed: some seven synusiae can be fairly easily distinguished as described below.

(a) Overstory. Emergents are absent from this particular stand but, judging by gallery forests at similar altitudes in the vicinity, tall *Anthocleista grandiflora* frequently grows as a scattered emergent in this community type.

(b) Canopy. The canopy is closed with small openings. It varies mostly between about 12 m and 15 m in height over the stream, curving down to about 6 m at places along the margins. *Syzygium cordatum* predominates accompanied by *Ficus capensis* with *Bridelia micrantha*, together with occasional fair-sized *Combretum kraussii*, *Curtisia dentata*, *Erythrina lysistemon*, *Ilex mitis* and *Rauvolfia caffra*.

(c) Understory (2 m to 6 m in height). The understory is composed of relatively few typical understory components. The more numerous of these are *Aphloia theiformis*, *Trimeria grandifolia* and *Cyathea dregei* (exceptionally up to 7 m tall), with occasional *Allophylus transvaalensis*, *Canthium inerme*, *Clausena anisata*, *Dombeya burgessiae*, *Euclea crispa*, *Eugenia natalitia*, *Maesa lanceolata*, *Maytenus mossambicensis* var. *mossambicensis*, *Ochna holstii*, *Pavetta barbertonensis* and *Tricalysia capensis*. Transgressive canopy trees are more abundant than understory trees proper.

(d) Shrub Layer (1 m to 2 m in height). This stratum is poorly developed on the whole, consisting of few and rather small shrubby plants. Fully grown *Argyrolobium tomentosum* may be locally fairly common. Also present are *Plectranthus fruticosus* and *Vernonia umbratica*, with occasional *Flemingia grahamiana*, small *Grewia occidentalis* and *Rhamnus prinoides*. Larger specimens of *G. occidentalis* and *R. prinoides* may be subscandent.

(e) Field Layer (up to 1 m in height). The field layer is conveniently regarded as falling into the following two sublayers:

(i) Low Soft Shrubs, Undershrubs and Taller Subwoody Herbs and Ferns. Codominant in this subclass are *Desmodium repandum* and *Phaulopsis imbricata* associated with *Asparagus virgatus*, with *Osmunda regalis* along the water's edge where the banks are rocky. The foregoing are accompanied by *Plectranthus laxiflorus*, *Thelypteris bergiana* and *T. madagascariensis* (in wet places near water), *Dryopteris inaequalis*, *Euphorbia kraussiana* (especially disturbed rocky sites), *Adenocline mercurialis*, smaller *Cyathula cylindrica*, *Dicliptera clinopodia*, *Pouzolzia parasitica*, *Stachys grandifolia*, *Tectaria gemmifera*, *Lantana mearnsii*, with occasional *Sida rhombifolia* ("forest" form), *Sparmannia ricinocarpa*, *Thunbergia natalensis*, *Triumfetta pilosa* var. *effusa* and *T. rhomboidea*. Larger *Cyathula cylindrica* tend to be subscandent.

(ii) Low Soft Herbs and Ferns. *Oplismenus hirtellus* clearly predominates in this sublayer, occurring in extensive societies where other plants are poorly represented or absent. *Dietes vegeta* and *Selaginella kraussiana* also tend to grow in societies owing to vegetative spread. The more abundant associated plants include *Carex spicato-paniculata*, *Ehrharta erecta*, and *Impatiens duthieae* and *I. sylvicola* (especially by the waterside). These are accompanied by *Crocosmia aurea* (gregarious), *Galopina circaeoides*, *Chlorophytum comosum* (gregarious), *Clivia caulescens* (especially rocky places), *Cyperus albostriatus*, *Achyranthes aspera*, *Aneilema aequinoctiale*, *Pellaea viridis*, *Crassula thorncroftii* (localised, near water), *Pavonia columella*, *Sanicula elata*, *Cardamine africana*, *Haemanthus magnificus* and *Streptocarpus parviflorus*. Occasional small colonies of *Peperomia retusa* grow on rocks.

(f) Ground Layer. A ground layer of mosses and hepatics is poorly developed, being mainly confined to rocks and, occasionally, wet earth near the water's edge.

(g) Lianoid Plants.

(i) Lianes and Scramblers. The more abundant robust lianoid plants capable of reaching the canopy are *Dalbergia armata*, *Smilax kraussiana*, and *Rhoicissus tomentosa*. They are accompanied by *Combretum gueinzii*, *Mikania cordata*, *Acacia ataxacantha*, *Choristylis rhamnoides*, *Rhoicissus rhomboidea*, *Entada spicata*, *Asparagus falcatus*, *Cnestis natalensis* and *Secamone gerrardii*, with occasional *Adenia gummifera*, *Rhamnus prinoides*, *Rhoicissus tridentata* and *Secamone alpinii*.

(ii) _Softer Slender Climbers._ Among the more abundant species of the less robust lianoid plants are _Behnia reticulata_, _Cissampelos torulosa_, _Ceratiosicyos laevis_ and _Dumasia villosa_ with occasional larger _Cyathula cylindrica_ (see above), _Dioscorea cotinifolia_, _Dioscorea retusa_, _Senecio tamoides_ and _Solanum bifurcum_.

(h) _Epiphytes._ Epiphytic plants are locally common to abundant especially on the lower limbs of large, old rough-barked trees particularly _Syzygium cordatum_. Lichens are prominent in the crowns and upper branches of canopy trees in particular. Festoons and loose mats of the Neckeraceous mosses _Pilotrichella chrysoneura_ and _P. panduraefolia_ are also found in favourable shady, damp and cool situations on the lower branches of the older trees. Smaller mosses, e.g. _Schlotheimia rufo-aeruginosa_ are also plentiful on the lower limbs and boles. The most abundant vascular species, in terms of plantlets, appears to be the mat-forming orchid, _Polystachya ottoniana_, associated with, and in sheer bulk probably exceeded by, _Polystachya imbricata_, a large-tufted species. The ferns _Pleopeltis macrocarpa_ and _Polypodium polypodioides_ subsp. _ecklonii_, the orchid _Polystachya_ sp., aff. _P. zambesiaca_ and various Jungermanniales, occur fairly frequently, together with scattered small groups of _Peperomia retusa_. Isolated plants of the ferns _Asplenium aethiopicum_ and _A. rutaefolium_ grow in the more favourable situations.

(3) _Ecological Notes._ The canopy is predominantly evergreen. A physiognomic feature of interest is the occurrence of aerial roots amongst several species of this community. When large and old, _Syzygium cordatum_ and _Ficus capensis_ are markedly buttressed, as are, to a lesser extent, _Bridelia micrantha_, _Cussonia spicata_ and _Ilex mitis_, especially near water and on rocky places. Besides well-developed root-thorns, _B. micrantha_ develops prop roots in moist places. Other adventitious roots are shown by the epiphytic orchids _Polystachya_ sp., aff. _P. zambesiaca_, _P. ottoniana_ and _P. imbricata_, as well as by the facultatively epiphytic or saxicolous or (as here) occasionally geophytic _Clivia caulescens_.

Various degrees of succulence are possessed by several of the epiphytic and field-layer constituents. _Peperomia retusa_ and _Crassula thorncroftii_ have succulent stems and leaves. _Impatiens duthieae_ and _I. sylvicola_ have succulent stems and semisucculent leaves, while _Polystachya_ sp., aff. _P. zambesiaca_ and _P. ottoniana_ possess succulent pseudobulbs and more or less subsucculent leaves. _Polystachya imbricata_, _Clivia caulescens_, _Chlorophytum comosum_ and _Haemanthus magnificus_ have semisucculent leaves.

Vegetative propagation occurs in _Ficus capensis_ and _Dietes vegeta_ by prolongations of compound-inflorescence axes (see p. 96 and p. 107). Vegetative spread also occurs in *Selaginella kraussiana* and occasionally in *Crassula thorncroftii* by fragmentation of the horizontally spreading and rooting stems. Propagation by means of gemmae takes place in *Tectaria gemmifera* and also, on occasion, in *Thelypteris madagascariensis* and *Asplenium rutaefolium*.

This community is apparently stable. Scrubby thickets of *Acacia ataxacantha* are clearly seral and will presumably thicken up with the influx of more mesophytic species, if undisturbed. Any natural changes in the gallery forest will proceed slowly, presumably in the direction of thickening up. *Syzygium cordatum* is likely to remain dominant but *Ficus capensis*, *Cyathea dregei*, *Ilex mitis* and *Bridelia micrantha* may possibly increase somewhat along the stream-banks. Away from the water's edge, an increase in the numbers of mesophytic trees seems probable. Such mesophytic trees are likely to include the following:

Bridelia micrantha
Ficus capensis
Dombeya burgessiae
Canthium inerme
Maytenus mossambicensis var.
Pittosporum viridiflorum
Trimeria grandifolia
Maytenus peduncularis
Pavetta barbertonensis
Rapanea melanophloeos
Trichilia sp. (*T. dregeana*?)

Aphloia theiformis
Bersama sp., cf. *B. transvaalensis*
Brachylaena transvaalensis
Combretum kraussii
Croton sylvaticus
Cussonia spicata
Euclea crispa
Eugenia natalitia
Ochna holstii
Rhus intermedia
R. chirindensis forma
Syzygium cordatum

Plate 19. Upper portion of kloof forest, Rosendal, merging into cliff forest at left background.

(D) CUSSONIA SPICATA-FICUS CAPENSIS ASSOCIATION

The description to follow is of a community or continuum represented by a rather discontinuous forest, which is very scrubby and impenetrable in patches apparently owing to disturbance, at least in places in the lower-lying parts. No other sample of this vegetation type is present and this stand had to be used, in spite of its shortcomings, for the description of this community type, which can be called "kloof forest".

(1) Locality. This heterogeneous community, situated between about 1125 m and 1200 m altitude, represents a transition between the gallery forest of the High Scrub Forest Zone and the forest of the Lower High Forest Zone. It is found along the banks of the upper Mtataspruit in a kloof running roughly east-west and ending rather abruptly beneath waterfalls near the boundary between Rosendal and the Grootbosch Government Forest Reserve (further notes on habitat are given under "Ecological Notes", below: p. 146-7).

(2) Structure and Composition. Because of the transitional nature of this community or continuum, many of the component species vary appreciably in relative numerical abundance from the higher to the lower-lying portions. Where this tendency is sufficiently noteworthy, the sign ↑ or ↓ will be placed in parentheses after the name of the species to indicate whether it is more abundant in the higher or lower levels respectively. In addition, the lower-lying portions seem to be the most disturbed, apparently because the upper reaches are practically inaccessible.

The canopy is irregularly closed to locally open. The trees are irregularly spaced except in the best-developed parts. Stratification is also variable in its development. While less strata are represented in the poorly developed parts, in the best-developed parts some six to eight synusiae can be distinguished as follows:

(a) Overstory. Apart from extreme irregularities of the canopy, a true overstory is absent except for a few localised emergent *Anthocleista grandiflora*, 15 m to 20 m tall, in the lower portions of the gallery forest.

(b) "Canopy". The dominant tree layer is irregularly closed, the height varying from less than 10 m to 15 m or more locally. It is dominated by *Cussonia spicata* in the upper portion, whereas *Ficus capensis* is more prominent in the lower portion. Associated trees are *Kiggelaria africana* (↑), *Nuxia floribunda* (↑) and *Trichilia* sp., cf. *T. dregeana* (↑), with Dombeya burgessiae up to about 7.5 m tall where the canopy is open. These species are accompanied by Croton sylvaticus, (Ficus capensis), Trema orientalis, Bridelia micrantha, Cryptocarya liebertiana, Ficus craterostoma, Drypetes gerrardii (↑, rocky places away from water) and Nuxia congesta, while occasionally Brachylaena transvaalensis, Halleria lucida and Rhus chirindensis forma legatii may contribute to the canopy.

In the lowermost portions, the canopy is more open and very mixed, dominated by full-grown and transgressive Bridelia micrantha and Ficus capensis, accompanied by Cussonia spicata. Other species occasionally present are Anthocleista grandiflora (localised transgressive), Brachylaena transvaalensis, Combretum kraussii, Croton sylvaticus, Cryptocarya liebertiana, Curtisia dentata*, Erythrina lysistemon, Halleria lucida, Ilex mitis, Nuxia floribunda, Rhus chirindensis forma legatii, Syzygium cordatum, Trema orientalis, Trichilia sp., cf. T. dregeana, Xymalos monospora and isolated Nuxia congesta.

(c) Understory or Small Tree Layer (2 m to 6 m in height). This stratum is poorly represented on the whole, being well developed only locally under closed-canopy conditions, mainly in the upper portion of the kloof. Where present, the understory is dominated by Xymalos monospora (mostly rather undersized), accompanied by fair-sized Maytenus mossambicensis var. mossambicensis, Rawsonia lucida, Trimeria grandifolia and Tricalysia capensis, with occasional Eugenia natalitia and Teclea natalensis. Elsewhere, Dombeya burgessiae is the most abundant small tree.

Aphloia theiformis, Halleria lucida, Cassipourea gerrardii (↑) and Rinorea angustifolia (↑) also occur, together with occasional Allophylus transvaalensis, Clausena anisata, Heteromorpha trifoliata, Maesa lanceolata, Ochna holstii, O. o'connorii (↑) and Oxyanthus gerrardii (↑). These species do not reach their best development here, however, being usually small especially at the lower levels, where they occur with transgressive Bridelia micrantha ( ) and Brachylaena transvaalensis.

(d) Shrub Layer (1 m to 2 m in height). The dominant shrub under a more or less closed canopy in the upper portions is Piper capense, which is scarce and only found near water in the lower part of the kloof. The most abundant associated shrub, occurring both under closed canopy and in the open is Plectranthus fruticosus (↑) accompanied by Sclerochiton harveyanus, Leonotis dysophylla, small Grewia occidentalis and occasional fair-sized Argyrolobium tomentosum and Cyathea dregei (locally, near water). Marattia fraxinea var. salicifolia, which is also

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* Relic after cutting by W. McDonald (see p. 5)

a localised waterside fern, can be considered to fall into this height class on account of its large fronds (to 2 m and more long).

(e) Field Layer (up to 1 m tall).

(i) Low Soft Shrubs, Undershrubs, Tall Subwoody Herbs and Ferns. Hypoestes verticillaris is the most abundant species in this sublayer. It is associated with the following more or less numerous species:

Desmodium repandum
Dicliptera clinopodia (↓)
Thelypteris bergiana (↓)
Pteris catoptera (↑)
Tectaria gemmifera
Coleus rehmannii (↑)
Dryopteris inaequalis
Fleurya mitis (often subscandent)
Plectranthus swynnertonii (↑)

Adenocline mercurialis
Blechnum attenuatum (↓)
Plectranthus laxiflorus (↑)
Thelypteris madagascariensis (↓)
Hypoestes phaylopsoides (↑, localised)
Pouzolzia parasitica
Stachys grandifolia (↑, localised)
Sida rhombifolia forest form (↓)
Solanum aculeatissimum (↑, canopy [opened)

The bracken-like fern Hypolepis sparsisora is locally common by the waterside in the open, while Polystichum ammifolium and Thalictrum rhynchocarpum are occasionally found in shaded places near water. Osmunda regalis also occurs locally near water and Begonia sonderiana is present at the bottom edge of the cliff forest in the scree on the north bank of the stream.

(ii) Low Herbs and Ferns. Oplismenus hirtellus is clearly the predominant species on the forest floor under a closed canopy. It is accompanied by the following more abundant species:

Impatiens duthieae and I. sylvicola (especially wet places near water)

Crassula thorncroftii (localised, especially wet places and seepages,
" where disturbed)

Selaginella kraussiana (" , " damp places under closed canopy)

Sanicula elata (especially disturbed " " " " ")

Galopina circaeoides (" " " " " " ")

Dietes vegeta (↓ " " " " " " ")

Chlorophytum comosum (" " " " " " ")

Pilea worsdellii (streamside and below waterfalls↑; seepage areas)

The above species are accompanied by Aneilema aequinoctiale, *Droguetia*? *woodii* (disturbed, shady places), *Panicum hymeniochilum* var. *glandulosum*, *P. monticolum*, *Adenostemma perottetii* (↓: localised, seepage areas), *Carex spicato-paniculata* (↓), *Cyperus albostriatus*, *Mariscus congestus* (near stream where canopy opened), *Cardamine africana* (disturbed shady places), *Haemanthus magnificus*, *Setaria chevalieri* (↓), with occasional *Commelina eckloniana*, *Ehrharta erecta* and very occasional *Floscopa glomerata* (seepage areas and near surface water). *Agrostis lachnantha* occurs along the stream in the open.

In addition, a number of species, especially facultative epiphytes, occur typically in accumulations of litter and duff on boulders and rocks, in very rocky places and sometimes in very humiferous soil in shady places, especially in the upper reaches of the kloof. Among the facultatively saxicolous epiphytes, the most abundant species is *Peperomia retusa*. It is accompanied by the following species:

Asplenium gemmiferum (on rocks in cool, damp, shady places near water)

A. splendens (" " " " " " " " " ; occasionally in humiferous soil)

A. inaequaelaterale (on rocks in " " " " " ")

A. sandersonii (" " " " " " " " ")

A. aethiopicum (" " " " " " " " " ; often in humiferous soil)

Trichomanes pyxidiferum var. *melanotrichum* (on rocks " " " " " " ")

Kalanchoe rotundifolia (localised, in sunny open places)

Streptocarpus parviflorus (" , " shady places)

Clivia caulescens (on rocks and especially in rocky shady places)

Asplenium rutaefolium (occasionally on rocks in cool, damp, shady places)

(f) Ground Layer. The ground layer is poorly developed except near the water's edge where hepatics, e.g. *Marchantia wilmsii* and Jungermanniales occur where light is not too poor. Very occasionally, colonies of *Riccia fluitans* are encountered in trickles of water from seepages. Away from the actual water's edge, a wide variety of mosses, e.g. *Porothamnium comorense*, and Jungermanniales are found in specific microhabitats, particular in the upper levels on rocks not too deeply covered by drifts of leaves.

(g) Lianoid Plants. Climbers and scramblers are strongly represented in this community - so much so as to render it practically impenetrable in parts. They contribute a great deal to the canopy, especially in places where it is low and the crowns of the trees are discontinuous. Because robust woody lianoid forms are more conspicuous components of the canopy, although smaller softer forms do contribute substantially to the canopy, climbers are conveniently subdivided on the basis of size and woodiness rather than on that of stratification.

(i) Lianes and Scramblers. The more abundant robust and woody lianoid plants are the following:

Mikania cordata
Rhoicissus rhomboidea (↑)
Canthium gueinzii
Cyphostemma anatomicum (↑)
Clematis brachiata
Rhoicissus revoilii (↑)
R. tomentosa (↑)
Adenia gummifera (↑)
Acacia ataxacantha (especially in the more open scrubby parts)
Entada spicata (↑)
Rubus pinnatus (↑)
Choristylis rhamnoides (↑)
Dalbergia armata
Vernonia mespilifolia
Asparagus falcatus (↓)
Cephalanthus natalensis
Scutia myrtina
Secamone alpinii
S. gerrardii
Cnestis natalensis
Cryptolepis capensis
Jasminum streptopus var.
*Passiflora edulis

(ii) Softer Slender Climbers. The more numerous less robust lianoid plants include Ceratiosicyos laevis, Senecio tamoides (↑), Behnia reticulata (↑), Coccinia variifolia (↑), Solanum bifurcum (↑), Dioscorea retusa, Tylophora flanaganii, Cissampelos torulosa, Senecio deltoideus, Dumasia villosa and Smilax kraussiana, with occasional Ipomoea wightii, Riocreuxia torulosa and Stephania abyssinica. Fleurya mitis may also adopt a lianoid habit in the dense upper levels.

(h) Hemi-epiphytic Stranglers. Ficus craterostoma (↑) occurs, at first, as a rather infrequent epiphyte which may later develop into a large canopy tree. Cussonia spicata sometimes starts life as an epiphyte, but then it grows very slowly until its roots reach the ground. It is unable to smother and supplant its supporting plant in the manner of a true strangler. Cussonia spicata seedlings and saplings on dead and rotting stumps and logs are more vigorous and capable of growing to full stature on the roots that have reached the ground.

(i) Epiphytes. The epiphytic lichens, e.g. species of Ramalina and Usnea, in the crowns and the Jungermanniales and mosses lower down, including Neckera valentiniana and Pilotrichella spp., are more frequent in the upper reaches of the kloof than at lower levels. The more abundant vascular epiphytes include Asplenium gemmiferum, with

Plate 20. Prop roots of Bridelia micrantha. The epiphytic moss is Neckera valentiniana.

A. rutaefolium and A. splendens together with occasional A. sandersonii in cool, damp, shady places near water.

(3) Ecological Notes. The canopy is predominantly evergreen with only a few semideciduous and isolated deciduous trees, e.g. Croton sylvaticus.

With further regard to physiognomy, the following trees become buttressed and fluted: Anthocleista grandiflora (↓), Bridelia micrantha (↓), Celtis africana, Cussonia spicata, Ficus capensis, F. craterostoma (by the coalescing of the aerial roots), Drypetes gerrardii (rocky places), Nuxia congesta, Scolopia zeyheri, Syzygium cordatum and Trichilia sp., cf. T. dregeana. In addition, Anthocleista grandiflora (↓) and Bridelia micrantha (↓) exhibit prop roots (in moist situations) while the latter also bears root thorns (see Plate 20). Aerial roots are also possessed by Ficus craterostoma and, occasionally, by Cussonia spicata. Adventive aerial roots are also borne by Clivia caulescens, Cyphostemma anatomicum, Piper capense and species of Rhoicissus in moist situations.

Vegetative propagation may be responsible for species aggregation in places. The ferns Asplenium gemmiferum, A. rutaefolium, A. sandersonii, Tectaria gemmifera and, sometimes, Thelypteris madagascariensis spread vegetatively by means of gemmae developed near the tips of the fronds. Dietes vegeta and Ficus capensis also spread vegetatively, as previously mentioned. The following plants root easily from the lower nodes of sprawling, trailing or rhizomatous stems sometimes resulting in vegetative spread and contributing to the denseness of the vegetation:

Adenostemma perottetii	Galopina circaeoides
Aneilema aequinoctiale	Hypoestes phaylopsoides
Commelina eckloniana	Hypolepis sparsisora
Crassula thorncroftii	Oplismenus hirtellus
Cyperus albostriatus	Panicum hymeniochilum var.
Desmodium repandum	P. monticolum
Dicliptera clinopodia	Piper capense
Droguetia woodii	Plectranthus swynnertonii
Ehrharta erecta	Selaginella kraussiana
Floscopa glomerata	Sclerochiton harveyanus

The strong development of lianoid plants is very striking. Some 37 species are represented of which about 30 are capable of reaching the canopy, at least where it is low. Over extensive areas, lianoid plants form an almost continuous low canopy over small trees, shrubs and even forbs, clothing the sides and much of the crowns of the scattered larger trees emerging from the uninterrupted mass of foliage (see Plate 19, p.141). This extreme development of lianoid plants, together with the discontinuous canopy, appears to be consequent upon the opening up of the canopy as a result of human interference. This interference, presumably the selective felling and removal of big timber, combined with a source of abundant seed (of lianoid plants) in the "cliff forest" above and to the north of this kloof forest (see p.174-8), seems to have resulted in the overwhelmingly luxuriant growth of lianoid plants. According to hearsay, W. McDonald, one-time owner of Rosendal, extracted timber, especially of *Curtisia dentata* and *Brachylaena transvaalensis*, for the manufacture and sale of felloes (see p. 5). Unfortunately, there is no authentic evidence of the extent of these operations. In any event, this seems to be an example of a subsere following deflected succession or a plagioclimax induced by disturbance, probably the selective cutting out of timber trees and the sawing up and removal of logs, intermediate or finished products by dragging, sled or waggon.

So dense and aggressive is the growth of the lianoid plants that, in combination with the often rocky and bouldery substratum, they constitute a factor prejudicial to the establishment and growth of trees in places. Competition for light is so severe that it is extremely difficult for tree seedlings to become established. Hardly has a stem or branch emerged from the mass of foliage when it begins to be rapidly covered over by lianoid stems, often to be deformed or even broken by their weight. Because of this inimical factor, it seems that the complete closing of the canopy and return of the vegetation to a presumably more natural condition will be an exceedingly slow process. However, it might be as well to maintain this kloof in a retarded successional state on hydrological grounds.

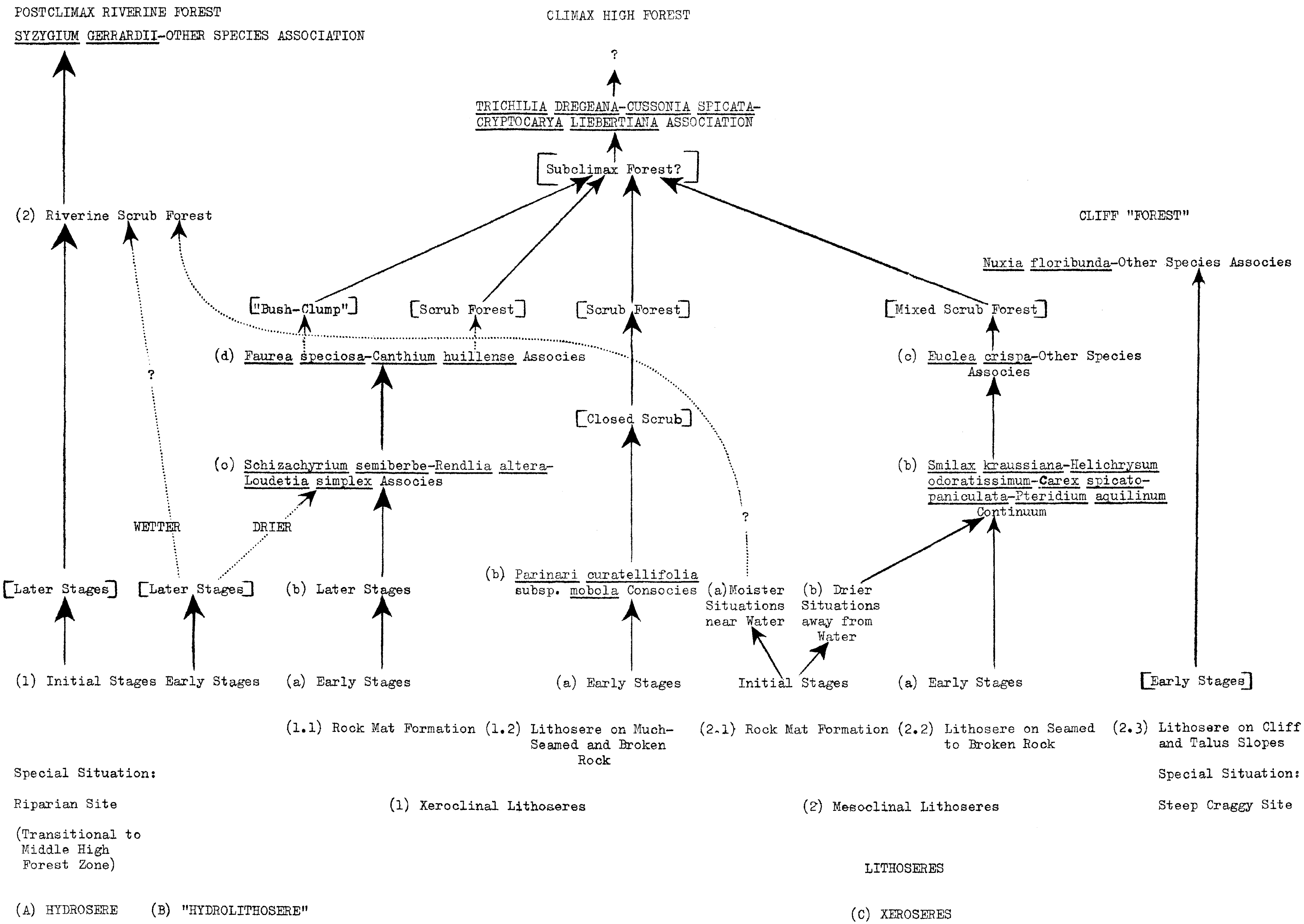

Fig. 8. Suggested successional trends and interrelationships of primary plant communities in the Lower High Forest Zone. Communities enclosed in square brackets are hypothetical.

CHAPTER VI

THE HIGH FOREST BELT

The Montane or High Forest Belt lies well within the Mistbelt, lying mainly above about 1200 m elevation. In this account, it is considered to comprise three zones, viz. the Lower, Middle and Upper High Forest Zones, lying at progressively higher altitudes. Of these three zones, only the two lower zones can be said to be represented on Westfalia Estate, although the transition from the Middle to the Upper High Forest Zones is closely approached by the high-level boundaries of the Estate. The Lower, Middle and Upper High Forest Zones are dealt with in that order in this Chapter.

A. THE LOWER HIGH FOREST ZONE

The Lower High Forest Zone lies mostly above about 1200 m elevation although its lower limits are raised to considerably higher levels (even above 1350 m) on xeroclines and in the vicinity of rain shadows. Of the vegetation zones described thus far, it presents the greatest area of vegetation in a natural and semi-natural state on Westfalia Estate.

PLANT SUCCESSION

1. PRISERES

Suggested successional trends and interrelationships of natural and semi-natural plant communities are indicated in Fig.8. As in the Scrub Forest Belt, little can be stated concerning the hydrosere in the High Forest Belt. Slopes are generally too steep to allow the collection of bodies of water of any size, but a brief discussion of the hydrosere in the Lower High Forest Zone is possible.

(A) THE HYDROSERE

(1) Initial Stages. The only collections of open water observed are small artificial pools formed by weirs (see Plate 21). *Juncus lomatophyllus*, *Helichrysum mundii*, *Panicum hymeniochilum* var. *glandulosum* and *Scirpus macer* have been seen to colonise open water. These pioneers are followed by and associated with *Coleus rehmannii*, *Impatiens duthieae*, *Polygonum nepalense*, *Pycreus elegantulus* and *Stachys grandifolia* amongst others. The habitat is clearly artificial, in this instance, which

Plate 22. Kloof forest of main eastern creek feeding Modyetsi Stream, southern face of Piesang Kop. *Ensete ventricosum* is scattered along tributary rivulet. Note luxuriant growth of lianoid plants.

probably accounts for the presence of Polygonum nepalense - a weedy species.

(2) Riverine Scrub Forest. This stand is considered to be a stage in the hydrosere culminating in riverine forest (see p.182-8). It is situated on a rather boggy stretch of the main western tributary of the Modyetsi Stream on the southern face of Piesang Kop, upstream of the rock mat communities of the creek (see p.165-7), at about 1200 m.

(2.1) Habitat. The local climate is probably very similar to that of the adjacent climax or subclimax forest (see p.178-81) edging the ridge to the east, but the site probably experiences less mist. It is much more sheltered from the wind.

The substratum consists of granite-gneiss bedrock overlain by shallow accumulations of moist to water-logged mainly alluvial soil, largely of a black vlei type with much organic matter, mostly poorly aerated and acid. The soils may be either unstabilised, as recently deposited alluvium or as quagmires probably mainly resulting from bush-pig activity, or stabilised, sometimes as a mat of rather meagre soil in an almost solid mass of roots. There is thus a variety of micro-habitats present. Where there is sufficient accumulation of alluvial soil and mud, seedlings may get little or no chance to become established in places, owing to the activities of bush pigs which rout about in the mud. Bush-pig activity also assists germination and thus furthers succession in the community as a whole.

(2.2) Structure and Composition. At this stage, the stand consists of young forest trees and scrub forest trees with a dense, tangled undergrowth forming a low "jungle" difficult to penetrate. Stratification is largely obscured in the thickets but several different synusiae can be distinguished.

(a) Tree Layer (mainly about 3.5 m to about 6 m in height). The tree layer is not, as yet, clearly differentiated into canopy and understory although there are signs of incipient stratification. The trees are very variable in height and do not form a closed canopy or form a very uneven canopy. Among the more common and conspicuous trees are Xymalos monospora, Trichilia dregeana, Maesa lanceolata, Halleria lucida, Nuxia floribunda, Cussonia spicata, Ilex mitis, Cussonia umbellifera, Syzygium cordatum, Cryptocarya liebertiana and Syzygium gerrardii with occasional Celtis africana, Pittosporum viridiflorum and Strelitzia caudata.

(b) Shrub Layer (about 1.5 m to 4 m in height). The most abundant shrub is Piper capense, forming impenetrable thickets in places, associated with Plectranthus fruticosus and accompanied by Eugenia natalitia, Peddiea africana and the tree fern Cyathea dregei. Also in this stratum are occasional specimens of Andrachne ovalis? (Clutia pulchella?), the giant herb Ensete ventricosum and the giant fern Marattia fraxinea var. salicifolia at the waterside, and the large shrub Maytenus mossambicensis var. mossambicensis. Small Ochna holstii and Tricalysia capensis occur in the shrub-layer height class, as well as transgressives of most of the species mentioned under the tree layer.

(c) Field Layer (up to about 1 m tall). The field layer is very discontinuous and not conspicuously differentiated into sublayers. Undershrubs are Desmodium repandum and Dicliptera clinopodia. Ferns present include Blechnum attenuatum, Thelypteris madagascariensis, Ctenitis lanuginosa and Asplenium aethiopicum? A. splendens?, with isolated A. gemmiferum growing on rock. Thelypteris bergiana is found more around the edges of this stand. Typical herbs are Cyperus pseudoleptocladus var. polycarpus, Impatiens duthieae, I. sylvicola, Calanthe natalensis, Pilea worsdellii, Dietes vegeta, Oplismenus hirtellus and Cardamine africana.

(d) Ground Layer. The very patchily developed ground layer consists almost solely of thalli of the liverwort Dumortieria hirsuta on rocks and mud.

(e) Lianoid Plants.

(i) Lianes and Scramblers. The more numerous and conspicuous robust lianoid plants include Rhoicissus rhomboidea, Mikania cordata, Dalbergia armata, Entada spicata, Rhoicissus tomentosa, Cyphostemma anatomicum, Canthium gueinzii, Rhoicissus revoilii, Jasminum streptopus var. transvaalense, Rubus pinnatus, Secamone alpinii and Vernonia mespilifolia, with isolated Adenia gummifera and Smilax kraussiana on the margin of the community.

(ii) Softer Slender Climbers and Scramblers. Although relatively few of the less robust species of lianoid plants are present, they are numerous and contribute much to the impenetrability of thickets. Conspicuous amongst these are Behnia reticulata, Dumasia villosa, Tylophora flanaganii, Ctenomeria capensis and Dioscorea retusa, with occasional subscandent specimens of Fleurya mitis.

(f) _Epiphytes_. Epiphytic plants are poorly represented in both number and variety. Neckeraceae and other mosses seem to constitute the bulk of the cryptogamic epiphytes. Vascular epiphytes are scarce, e.g. _Asplenium rutaefolium_, _A. aethiopicum_ and _A. gemmiferum_, with _Peperomia retusa_.

(2.3) _Ecological Notes_. This evergreen community shows signs of further development if not disturbed. The tree layer will probably soon develop a closed canopy with concurrent differentiation of an understory. At the same time, it is probable that mesophytic and hygrophilous high forest trees will increase at the expense of scrub and scrub forest elements, as is already evident in the undergrowth and in an intermediate stage of development adjacent to the stand described above.

This trend is likely to result in a stand of riverine or kloof forest in which the following species will play a conspicuous rôle:

Canopy:

Syzygium cordatum, _S. gerrardii_, _Cussonia spicata_, _C. umbellifera_, _Ilex mitis_ (waterside), _Celtis africana_, _Cryptocarya liebertiana_, _Harpephyllum caffrum_, _Nuxia floribunda_, _Rhus chirindensis_ forma _legatii_, _Trichilia dregeana_ and _Xymalos monospora_;

Understory:

Xymalos monospora, _Eugenia natalitia_, _Halleria lucida_, _Ochna holstii_, _Rawsonia lucida_, _Rinorea angustifolia_, _Tricalysia capensis_, _Cassipourea gerrardii_ and _Diospyros whyteana_;

Shrub Layer:

Plectranthus fruticosus, with _Marattia fraxinea_, _Piper capense_ and, possibly, _Vernonia umbratica_, in shaded waterside situations, together with, perhaps, _Cyathea dregei_ and _Ensete ventricosum_ (waterside). _Cyathea dregei_ and _Ensete ventricosum_ will probably eventually be confined to the sunnier waterside situations (see Plate 22).

Lianoid Plants:

A great wealth of lianoid plants is likely to contribute substantially to the closing of an irregular canopy (see Plate 22). This is a common feature of kloof communities (see p.144-6).

(B) THE "HYDROLITHOSERE"

Seepage areas on rock are extremely limited in extent in the High

Forest Belt, and moreover, non-perennial as a rule. The only hydrolithoseral stages seen are associated with the rock mat formation on the upper slopes of the north-facing granite-gneiss rock sheet on the northwestern slopes of Piesang Kop. In the absence of any other information, this sere merits only passing mention.

The wet rock surfaces are characteristically first colonised by Cyanophyta and various Algae and Bryophyta. These are followed by Antherotoma naudinii, Bulbostylis densa*and Utricularia livida (cf. p.69&71), growing in a very shallow substratum of dust and organic matter accumulated by the initial stages of the sere. This stage which may also include less specialised plants is soon followed by the entry and luxuriant growth of Panicum maximum, Hyparrhenia hirta, Stereochlaena cameronii, Melinis minutiflora, Hypoestes aristata, Coleochloa setifera and Kalanchoe rotundifolia together with such herbaceous weeds as *Ageratum conyzoides, Triumfetta pilosa var. effusa, *Tagetes minuta and Commelina diffusa.

As in the case of the hydrolithosere in the Lowveld Sour Bushveld Transition Zone, it is to be expected that the extent and species composition of the hydrolithosere, especially the initial stages, will fluctuate considerably with the wetness or dryness of the season, year or longer period.

(C) THE XEROSERES

LITHOSERES

Extensive primary bare surfaces of granite-gneiss bedrock in the Lower High Forest Zone are mainly limited to the northern to northwestern slopes of Piesang Kop above about 1300 m elevation. Smaller primary bare rock areas are found on the mesoclinal slopes between about 1125 m and 1200 m. The rocky summit portions are considered to fall into the Middle High Forest Zone (see p. 189 et seq.). The xeroclinal and mesoclinal lithoseres will be considered separately, as will the rock mat formation of each, as opposed to the seamed, jointed and broken or tumbled rock and cliff habitats.

(1) Xeroclinal Lithoseres.

(1.1) Rock Mat Formation. The following description is based on the north- to northwest-facing rock sheet in the southern part of the eastern boundary of the Westfalia Estate portion of Christinasrust, above about 1300 m elevation on Piesang Kop.

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* Fimbristylis capillaris Kunth var. trifida (Nees) Koyama =[Bulbostylis trifida (Nees) Nelmes] [= B. densa (Wall.) Hand.]

Plate 23. Earlier stages of rock mat formation of xeroclinal lithosere, Lower High Forest Zone, Piesang Kop. Aspect dominated by large tufts of *Coleochloa setifera*.

(a) Early Stages. Succession on the solid rock is commonly initiated by vascular plants in crevices and depressions where water can collect, together with organic remains, dust and soil particles. Crustose lichens may be locally conspicuous but do not appear to play an important part in the xeroclinal lithosere (cf. Cooper & Rudolph, 1953).

The pioneers are commonly *Coleochloa setifera*, a densely tufted sedge (see Plate 23) usually confined to crevices, and also *Selaginella dregei*, a moss-like mat-forming plant which can also colonise small depressions in the surface of the solid rock. On occasion, *Aeolanthus rehmannii* and, still more rarely, *Pellaea viridis*, *Crassula muscosa*, *Loudetia simplex* and *Stereochlaena cameronii* may be pioneers of crevices.

Being almost confined to crevices, the optimum size of a clump of *Coleochloa setifera* is reached or exceeded when the length of the crevice is choked up with the dense mass of stems and roots. After this optimum size has been reached, portions of the tufts may be dead or sufficiently moribund to provide a suitable substratum for *Aeolanthus rehmannii*, *Pellaea viridis*, *Crassula* sp., aff. *C. nodulosa*, *Kalanchoe rotundifolia*, *Iboza riparia*, *Vellozia villosa*, *Aloe greatheadii*, *A. lettyae*, *Chlorophytum bowkeri*, *Cyanotis nodiflora*, *Pellaea calomelanos* and *Senecio orbicularis*. These species may occur within clumps of *Coleochloa setifera* but tend to be found on the peripheries along with *Selaginella dregei*, *Crassula muscosa*, *Stereochlaena cameronii*, *Aristida transvaalensis* and *Melinis minutiflora*, together with isolated *Cynanchum tetrapterum*. *Stereochlaena cameronii* can form long stolons which can quite effectively cover considerable areas of bare rock or sites of former *Coleochloa* clumps. *Selaginella dregei* and, to a lesser extent, *Crassula muscosa* and *Melinis minutiflora* also spread laterally over the rock surface. These properties aid in extending the sphere of influence of crevice communities.

(b) Later Stages. Other species soon follow the first-mentioned pioneers, e.g. *Melinis minutiflora*, *Hyparrhenia hirta*, *Rhynchelytrum repens*, *R. rhodesianum*, *Setaria sphacelata*, *Panicum maximum* and occasional *Kalanchoe thyrsiflora*. If space and soil depth permit, such weeds as *Triumfetta pilosa* var. *effusa*, *T. rhomboidea*, *Commelina diffusa*, *Senecio pterophorus*, **Ageratum conyzoides*, **Bidens pilosa*, **Tagetes minuta* and *Vernonia fastigiata* may enter the sere at this stage, later to be ousted by or have their entry prevented by subwoody and other longer-lived plants including the following:

Forbs and Shrubs	Small Trees
Vernonia natalensis	Lannea discolor
Pelargonium luridum	Vangueria infausta
Selago natalensis	Combretum gueinzii
*Cassia laevigata	Ziziphus mucronata
Lippia javanica	Terminalia sericea
Hypoestes aristata	Acacia ataxacantha
Iboza riparia	Heteromorpha trifoliata
Lannea edulis	Heteropyxis natalensis

Once sufficient soil has been accumulated, even such forest precursors as Combretum kraussii and Brachylaena transvaalensis are enabled to invade the herbaceous stages.

Variations on the above general account, associated with variations in microhabitat, occur. For instance, the rock mat formation, on a rock sheet to the west and somewhat to the south of the main sheets, is remarkable for the conspicuous development of crustose lichens, e.g. Caloplaca cinnabarina, Buellia sp. and B. stellulata. Caloplaca cinnabarina is present in such quantity as to impart to the rocks a distinctly paint-bedaubed appearance, which is clearly visible from a distance. There is also much Vellozia villosa, as well as Coleochloa setifera. Moreover, in addition to mosses, Selaginella dregei and the above species, which form a dense mat of organic and trapped inorganic matter, Eriospermum tenellum, Oxalis obliquifolia and Raphionacme hirsuta occur with Scilla natalensis, Senecio orbicularis and S. othonniformis, together with Vangueria infausta in rock crevices.

Where the rock sheet has deep crevices, Crassula rubicunda and Vellozia villosa participate in the earliest stages of succession, followed at a later stage by Cryptolepis oblongifolia among other species. Where the rock surface is more jointed, broken-up, irregular and often steeper, the crevices and pockets are colonised by Notholaena eckloni, Pellaea calomelanos, Hyparrhenia cymbaria, Eragrostis capensis, Cyanotis nodiflora, Selago natalensis and Vernonia natalensis.

The foregoing successional stages would appear to culminate in various types of sour grassveld depending upon the successional stages and the depth and rockiness of the soil. These types of sour grassveld may later become progressively more encroached on by woody plants, e.g. Acacia ataxacantha, either more or less uniformly throughout the stand or at first aggregated into bush-clumps. The actual course of succession seems to depend upon the uniformity of depth of the soil accumulated on uninterrupted or variously seamed and jointed stretches of bedrock. By increase in number and stature of the woody plants, scrubby consocies or associes of Acacia ataxacantha, Canthium huillense, Faurea speciosa, Parinari curatellifolia subsp. mobola and other species may arise.

Plate 24. Northwest-facing xeroclinal lithoseral grassveld glade, Piesang Kop (Christinasrust)

The preponderance of Acacia ataxacantha in early stages of thickening up of the rank grassveld on rock mats, may be taken as a sign of past disturbance as confirmed by scrutiny of old aerial photographs. The samples of an Acacia ataxacantha Consocies and a Canthium huillense Consocies investigated are evidently secondary in origin and are discussed in the section dealing with subseres (see p.24-6 & p.22-4, Appendix A). However, they do serve to indicate the possible further course of succession after the grassveld stages of the primary lithosere.

An example of arrested development at an earlier and clearly lithoseral stage is provided by the following community.

(c) Schizachyrium semiberbe - Rendlia altera - Loudetia simplex Associes. This community is confined to a small glade (see Plate 24) between the westernmost small upper northwest-facing rock sheet (see p. 154) and the Faurea speciosa - Canthium huillense scrub (see p.158-61) to the north of the firebreak running more or less east-west over the western summit portion of Piesang Kop.

(i) Habitat. The glade lies between about 1350 m and 1400 m elevation. The lower portion is very rocky with pockets of vegetable matter, humus and siliceous soil, accumulated over seamed and jointed granite-gneiss, changing gradually upwards to the upper portion where a fairly continuous but shallow mat of soil has been built up on a somewhat less seamed and jointed sheet of granite-gneiss.

The slope is moderately steep to steep, averaging between 20° and 25° from the horizontal. The aspect is roughly 30° west of due north so that the slope is potentially exposed to intense sunshine in the afternoon and most of the morning throughout the year. The site is well drained to very dry and, moreover, exposed to almost all except southerly to southeasterly winds. Mist is wafted over the site from time to time, but this happens infrequently and does little to relieve the prevailing relatively dry conditions.

(ii) Structure and Composition. The community as a whole is dominated, as far as the numerical abundance of individuals is concerned, by Schizachyrium semiberbe, which predominates in the lower broken rocky portion and is relatively infrequent in the upper part. In the following description the signs ↑ and ↓ in parentheses will signify whether the corresponding species tends to be more abundant in the upper or lower portions, respectively. Subdominants are the large-tufted Rendlia altera* (↑), which contributes much cover and becomes the

* This species appears to occur nowhere else on Westfalia Estate.

dominant grass in the upper portion, and Loudetia simplex (↑), which also shows a tendency to become more abundant in the upper portions. Associated herbs, ferns and suffrutices are the following:

Acalypha schinzii (↑)
A. wilmsii (↑)
Hypoestes aristata (↓)
Panicum natalense (↓)
Clutia monticola
Rhynchelytrum repens (↑)
Scilla natalensis (↓)
Cassinia phylicaefolia (↓)
Helichrysum odoratissimum (↑)
Aeschynomene rehmannii var. (↓)
Helichrysum umbraculigerum (↑)
Pentanisia prunelloides (↑)
Andropogon amplectens (↓)
Athrixia phylicoides
Pellaea viridis (↓)
Helichrysum polycladum (↑)
Triumfetta welwitschii var. (↑)
Aristida transvaalensis (↓)
Conostomium natalense var. (↓)
Crassula sp., aff. C. nodulosa (↓)
Cymbopogon validus (↓)
Endostemon obtusifolius
Eupatorium africanum (↑)
Oxalis obliquifolia (↑)
Rhynchosia monophylla
Schoenoxiphium sparteum
Fadogia monticola
Setaria sphacelata
Rhynchosia angulosa (↓)
Aloe boylei
Arthrosolen microcephala
Cyanotis nodiflora (↓)
Callilepis salicifolia (↓)
Eragrostis racemosa (↓)
Helichrysum lepidissimum
H. setosum (↑)
Pteridium aquilinum (↓)
Vernonia natalensis (↓)
Agapanthus inapertus

Aloe greatheadii
Andropogon filifolius
Aristea woodii
Aspilia africana
Berkheya insignis
Chaetacanthus setiger
Cyperus albostriatus
Eragrostis curvula
Eucomis undulata
Harpechloa falx
Helichrysum nudifolium var.
Knowltonia transvaalensis
Pelargonium luridum
Setaria flabellata
Tristachya hispida
Tulbaghia alliacea
Aeschynomene sp. (A. nyassana?) [(Cassia mimosoides ?)
Alepidea gracilis var.
Argyrolobium adscendens
Eulophia parvilabris
Helichrysum acutatum
Hibiscus sp., cf. H. aethiopicus [var.
Indigofera sanguinea
Kohautia amatymbica
Monocymbium ceresiiforme
Nidorella auriculata
Paspalum commersonii
Satureia biflora
Scabiosa columbaria
Schistostephium crataegifolium
Selago natalensis
Sporobolus pyramidalis
Themeda triandra
Thesium sp., cf. T. costatum
Thunbergia atriplicifolia
Triumfetta pilosa var. effusa
T. pilosa var. tomentosa
T. rhomboidea
Vellozia villosa

In addition, occasional Moraea sp., Hemizygia rehmannii and Hypericum aethiopicum subsp. sonderi are to be found in the rather broken rocky uppermost eastern portion.

Shrubby plants are poorly represented both in number and in kind. The more conspicuous species include Vernonia ampla (↑), Indigofera swaziensis, Pearsonia aristata (↓), Iboza riparia (↓), Lippia javanica, Pseudarthria hookeri and Vernonia corymbosa.

When investigated in early 1962, numerous small trees and other woody plants were encroaching on the grassveld, notably the following:

Faurea speciosa
Acacia davyi (↑)
Brachylaena transvaalensis
Acacia ataxacantha
Canthium huillense (↓)
Maesa lanceolata
Combretum gueinzii (↓)
Heteropyxis natalensis
*Psidium guajava
Vangueria infausta
Rhus rehmanniana
Euclea crispa

Protea rhodantha (↓)
Dombeya rotundifolia
Ficus capensis (↑)
Apodytes dimidiata (↑)
Rhus leptodictya (↓)
Anthospermum ammanioides
Combretum kraussii
Fagara davyi (in bush clumps)
Faurea saligna
Maytenus heterophylla
Nuxia congesta
N. floribunda
Peltophorum africanum

In addition to the above species which occur throughout the glade as scattered individuals, Parinari curatellifolia subsp. mobola is found in the marginal scrub edging the adjacent scrub forest at the top end, together with the lianoid Cephalanthus natalensis and Clematis brachiata. An isolated specimen of Protea gaguedi was also noted at the top end of the glade - the only specimen seen on the Estate. Beard (1958) considers P. gaguedi to be typical of the ecotone between highland sourveld and bushveld rather than characteristic of these main groups of veld types in their typical form. This would thus also appear to apply to the transitional region between Acocks' (1953) North-Eastern Mountain Sourveld and his Lowveld Sour Bushveld. Although there seems to be a general thickening up of woody plants throughout the glade, as well as encroachment from the marginal scrub areas, incipient bush clumps have also been observed. Transgressive forest precursors, e.g. Fagara davyi, have been observed in the undergrowth of these bush clumps.

At the lower edge of the glade, the scrub is rather more open and xerophytic in facies than the scrub at the top edge, although more impenetrable owing to the luxuriant growth of Smilax kraussiana and Pteridium aquilinum. The more abundant woody and subwoody plants of the lower edge of the glade are Acacia davyi, A. ataxacantha, Catha edulis (gregarious), Combretum gueinzii, Faurea speciosa, Heteropyxis natalensis, Canthium huillense, Rhus intermedia, Brachylaena transvaalensis, Cussonia spicata, Vernonia corymbosa, V. hirsuta, Flemingia grahamiana, Indigofera swaziensis, Athrixia phylicoides, Aspilia africana and Pteridium aquilinum. The most abundant associated lianoid plants are Smilax kraussiana, Clematis brachiata and Sphedamnocarpus galphimiifolius.

(iii) Ecological Notes. Despite the steep slope and the considerable area of bare soil between the bases of the tufts, little evidence of erosion could be seen. This appears to be partly owing to reduced rainfall per unit surface area on the steep slope facing away from the prevailing rain-bearing winds and partly owing to the appreciable interception of rain by the masses of dead and living material produced by the unburned vegetation, especially the tufted _Rendlia altera_. _Rendlia altera_ was not seen to flower on the site. Tufts transplanted and burnt in the spring were, however, induced to flower. The indications on the site were that, in the absence of burning, many grass tufts especially _R. altera_, were accumulating quantities of dead foliage and stems which were obstructing and shading fresh growth and reducing vigour. As a result, taller grasses such as _Cymbopogon validus_, subwoody forbs and woody plants appeared to be gaining the upper hand.

This community appears to be derived from northwest-facing lithoseral stages initiated by crustose lichens such as _Buellia_ sp., _B. stellulata_ and _Caloplaca cinnabarina_ and further characterised by _Coleochloa setifera_ and much _Vellozia villosa_, together with _Eriospermum tenellum_, _Oxalis obliquifolia_, _Scilla natalensis_, _Senecio orbicularis_ and _S. othonniformis_ (cf. p. 154).

The glade is at present being rapidly encroached upon and invaded by trees of the scrub which surrounds it almost completely, more especially by _Faurea speciosa_, _Acacia davyi_, _Brachylaena transvaalensis_, _Acacia ataxacantha_, _Canthium huillense_, _Maesa lanceolata_ and _Combretum gueinzii_. The indications are that the stand will thicken up to form a type of _Faurea speciosa_ - _Canthium huillense_ Associes, similar to that described below, i.e. a Mistbelt scrub with Low Country affinities as indicated by _Faurea saligna_, _Peltophorum africanum_, _Pseudarthria hookeri_ and _Rhynchosia komatiensis_ which are among the species invading the glade.

(d) _Faurea speciosa_ - _Canthium hüillense Associes_.

The stand of seral scrub described below lies mainly just to the west and southwest of the preceding community.

(i) _Habitat_. This community lies at an elevation of about 1400 m. The site has a more or less northwesterly aspect, the slope averaging between 10^{o} and 15^{o} from the horizontal, and is exposed to intense sunshine most of the time and to most winds except those from the southeast, being near to the crest of the ridge. The climate is mostly relatively cool, with fairly frequent mist at times.

The soil, distributed in shallow mats and pockets over and between granite-gneiss rocks, varies from a fairly humiferous and granular, friable siliceous sandy clay loam to accumulations of litter and duff under closed canopy. Accumulations of duff and litter are mostly fairly deep. As a result, little run-off and erosion take place except after heavy downpours.

(ii) Structure and Composition. Owing to the scrubby tangled nature of this community, stratification is much obscured. Nevertheless, the following six or seven synusiae can be discerned:

Tree Layer. The "canopy" is open to irregularly closed, consisting mainly of small trees and large shrubs, from about 2 m to about 8 m in height. Codominant are the small trees or large shrubs *Faurea speciosa* and *Canthium huillense*. Associated species are mostly small trees, many of which are potentially taller. The more abundant and conspicuous associated species are the following:

Acacia davyi
Rhus intermedia
R. transvaalensis
Euclea crispa
Cussonia spicata
Ficus capensis *
Rhus chirindensis forma
Vepris undulata * (localised)
Allophylus transvaalensis
Brachylaena transvaalensis
Canthium inerme
Combretum kraussii
Maytenus mossambicensis var. *
Ochna holstii *
Scolopia zeyheri *
Apodytes dimidiata
Combretum gueinzii
Curtisia dentata
Eugenia natalitia *
Maesa lanceolata
Maytenus heterophylla
Syzygium cordatum
Vangueria infausta
Ziziphus mucronata
Trichilia dregeana

Despite their ability to grow erect without support on occasion, *Acacia ataxacantha* and *Grewia occidentalis*, which also contribute to the "canopy", are here considered to fall into the synusia of lianes and scramblers in view of their normally scrambling habit.

Shrub Layer (1 m to 2 m in height). The more abundant shrubs in this Associes include *Vernonia corymbosa*, *Rhynchosia komatiensis*, *Pseudarthria hookeri*, *Diospyros lycioides* subsp. *sericea*, *Flemingia grahamiana*, *Lantana mearnsii*, *Vernonia ampla* and occasional *Clutia affinis* and *Lippia javanica*, as well as small *Grewia occidentalis* of more or less erect habit.

Field Layer (up to about 1.5 m in height):

Low Soft Shrubs, Undershrubs and Taller Herbs and Ferns (0.5 m to about 1.5 m tall). This subclass, as well as the field layer as a whole, is dominated over most of the area by *Hypoestes aristata*. *Hyparrhenia cymbaria* and the bracken fern, *Pteridium aquilinum*, may be locally fairly abundant. The following

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* In "bush-clump" succession about old *Ficus capensis*: see (iii) Ecological Notes, below.

associated species are more or less frequent:

Endostemon obtusifolius
Setaria sphacelata
Thunbergia natalensis
Carex spicato-paniculata
Cymbopogon validus
Nidorella auriculata
Senecio junodii
Triumfetta pilosa var. effusa
Plectranthus calycinus
Asparagus virgatus
Pouzolzia parasitica
Leonotis dysophylla
Pavonia columella
Phyllanthus nummulariaefolius
Athanasia punctata
Cineraria fruticetorum
Hebenstreitia comosa
Helichrysum nudifolium var.
H. setosum
H. umbraculigerum
Justicia cheiranthifolia
Panicum maximum
Schistostephium heptalobum
Senecio pandurifolius
Sparmannia ricinocarpa
Vernonia hirsuta

Low Soft Herbs and Ferns (up to about 0.5 m tall). This sublayer is rather suppressed, for the most part, by that just described. Galopina circaeoides* and Oplismenus hirtellus* may locally dominate the floor under a closed canopy. Less frequent on the whole are Cyperus albostriatus, Acalypha wilmsii, Fadogia monticola, Conostomium natalense var. glabrum, Cyphia elata, Haemanthus magnificus, Commelina sp. and Pellaea viridis, with occasional Zantedeschia tropicalis.

Ground Layer. Apart from infrequent colonies of mosses, e.g. Levierella fabroniacea var. abyssinica* and Hyophila atrovirens*, on exposed surfaces of granite-gneiss rocks and boulders, there is generally too great an accumulation of litter on the ground to allow the development of a ground layer.

Lianoid Plants:

Lianes and Scramblers. The more robust lianoid plants contributing towards the formation of a canopy include Sphedamnocarpus galphimiifolius, Smilax kraussiana, Acacia ataxacantha, Riocreuxia torulosa, Rubus pinnatus, Clematis brachiata, Canthium gueinzii*, Grewia occidentalis, Rhoicissus tomentosa, R. rhomboidea and occasional Cephalanthus natalensis.

Slender, Softer Lianoid Plants. Among the more numerous, less robust scandent and subscandent plants present are Adenia digitata, Stephania abyssinica, Rhoicissus tridentata, Senecio deltoideus, Asparagus asparagoides, Cissampelos torulosa, Cyphia transvaalensis, Cyphostemma cirrhosum subsp. transvaalense, Abrus

* Participating in "bush-clump" succession about old Ficus capensis: see (iii) Ecological Notes below.

fruticulosus and occasional Cyphostemma woodii.

Epiphytes. Apart from epiphytic lichens and mosses, epiphytes are rather rare, occurring only on the older and larger trees, especially of the bush-clump succession (see below), e.g. Ficus capensis, and also on Brachylaena transvaalensis and Cussonia spicata. The vascular epiphytes noted were the ferns Pleopeltis macrocarpa* and Polypodium polypodioides subsp. ecklonii* and the orchid Polystachya ottoniana*.

(iii) Ecological Notes. The stand appears to be undergoing a rapid change in composition as the canopy closes. Apart from the greater portion of the stand which seems to have arisen by general thickening up of grassveld, this stand includes a portion which appears to have developed from a "bush clump" formed around a fair-sized, now overmature specimen of Ficus capensis. The species involved in this "bush-clump" succession, indicated in the foregoing description by asterisks, are generally more mesophytic than the constituent species of the greater portion of the stand. The former are, viz., Ficus capensis, Vepris undulata, Maytenus mossambicensis var. mossambicensis, Ochna holstii, Scolopia zeyheri, Eugenia natalitia, Galopina circaeoides, Oplismenus hirtellus, Canthium gueinzii, Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana.

It seems likely that, if undisturbed, the bush clump will increase in area and height until a patch of subclimax forest develops. Canopy components of such a subclimax forest would probably include Cussonia spicata, Combretum kraussii, Allophylus transvaalensis, Scolopia zeyheri, Brachylaena transvaalensis, Apodytes dimidiata, Ficus capensis, Trichilia dregeana and Vepris undulata, possibly with Cryptocarya liebertiana and Syzygium cordatum. Ochna holstii and Eugenia natalitia are likely understory trees, with Clematis brachiata, Canthium gueinzii, Rhoicissus tomentosa, R. rhomboidea, Cephalanthus natalensis and Senecio deltoideus among the associated lianoid plants. Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii, and Polystachya ottoniana can be expected to persist in the epiphyte flora, possibly with the eventual addition of Asplenium rutaefolium and Tridactyle tricuspis.

* In bush clump.

Plate 25. Sudden transition from rock mat formation (foreground) to lithosere on broken rock (background), Piesang Kop. Foreground dominated by Coleochloa setifera.

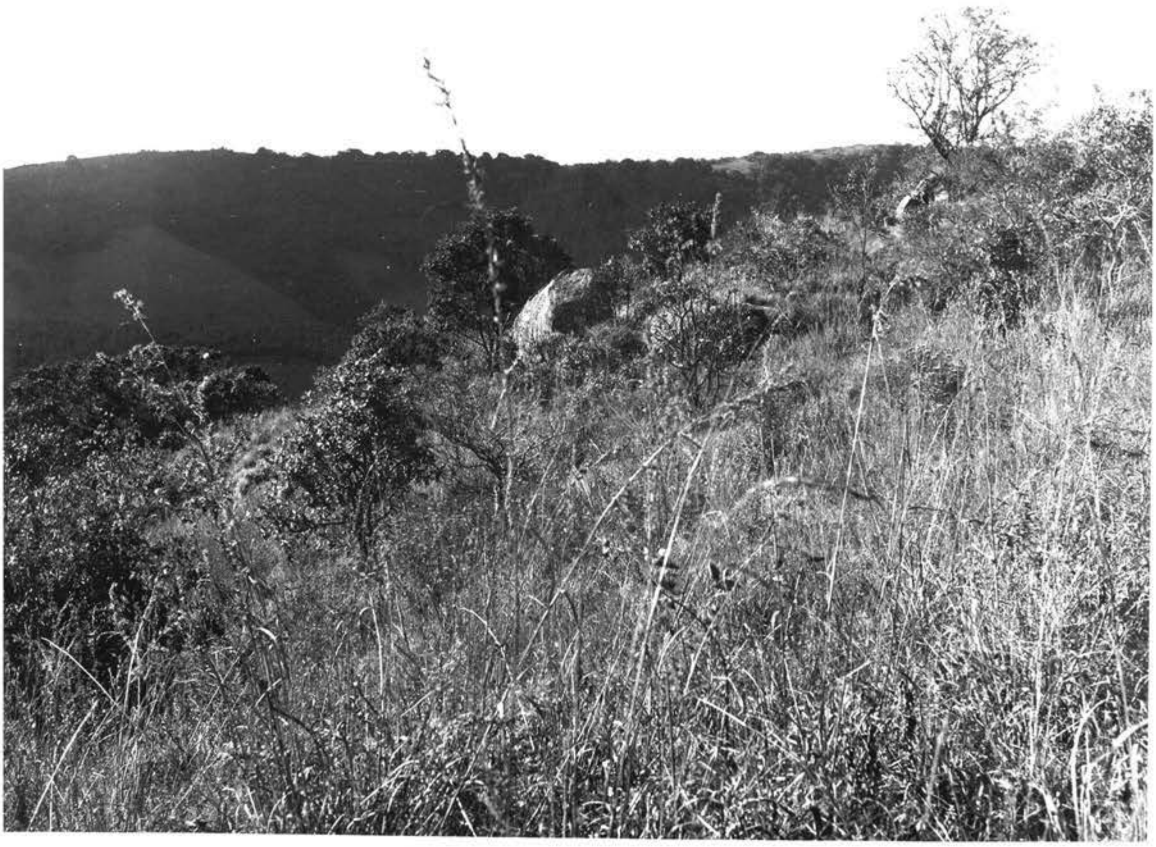

Plate 26. Scrubby broken rocky sour grassveld, xeroclinal lithosere of northwestern slopes of Piesang Kop in Lower High Forest Zone. Rakgwale Ridge (Christinasrust-Kort Hannie) in background.

(1.2) Lithosere on Much-Seamed and Broken Rock. Where the surface is much broken, *Coleochloa setifera* and other pioneers may not make an appearance but less specialised herbs, shrubs and even trees may initiate the succession in the crevices and pockets (see Plate 25). The more important of these is included in the following list:

Panicum natalense
Monocymbium ceresiiforme
Crassula rubicunda
Habenaria sp. (cf. Scheepers 915)
Gladiolus sp., cf. *G. crassifolius*
Cymbopogon validus
Hemizygia rehmanniana
Fadogia monticola
Cassinia phylicaefolia
Artemisia afra
Indigofera swaziensis
Cryptolepis oblongifolia
Eriosema polystachyum
Lantana mearnsii
Ficus petersii
Canthium huillense
Maytenus heterophylla
Rhus rehmanniana
Pterocarpus rotundifolius
Faurea speciosa
Brachylaena transvaalensis

A more complex community than those of rock mats has developed on the more level yet broken rock surfaces as, for instance, slightly south and to the west of the main rock sheet, viz. a rather xerophytic scrubby grassveld with scattered trees (see Plate 26). *Acacia ataxacantha* plays a leading rôle in the thickening up of this veld, presumably giving rise to a type of *Acacia ataxacantha* scrub, similar to that occurring below the rock faces, as described under the High Scrub Forest Zone (see p. 115 *et seq.*).

A further example of succession on a much broken rock surface, probably more or less intermediate between those of the High Scrub Forest and Lower High Forest Zones, is provided where the seamed sheet of granite-gneiss in the former zone (see p. 113 *et seq.*) gives way at its upper end to a strip where the rock surface is much broken up in a small kloof or cleft. This broken strip extends up to nearly 1300 m elevation, i.e. lower than the arbitrarily selected 1350 m boundary between the High Scrub Forest and the Lower High Forest Zones for this rain-shadow locality. Because the lithoseral stages represented along this marginal site probably parallel those to be expected in the Lower High Forest Zone, they are briefly described below:

(a) Early Stages. As usual in this type of situation, the succession proceeds irregularly and rapidly, with trees becoming established in crevices and pockets at an early stage. Early stages of succession are typified by *Coleochloa setifera*, *Pellaea viridis*, *Notholaena ecklonii*, *Rhynchelytrum repens*, *Microchloa caffra*, *Melinis minutiflora*, *Hyparrhenia hirta*, *Cyperus albostriatus*, *Cyanotis nodiflora*, *Commelina* sp. (*C. diffusa*?), *Chlorophytum bowkeri*, *Kalanchoe rotundifolia* and *Vellozia villosa* with occasional *Setaria chevalieri*. Such weeds as

Triumfetta pilosa var. effusa, T. rhomboidea and Pavonia columella also occur together with the suffrutescent Justicia cheiranthifolia and Fadogia monticola, and low shrubby plants such as Iboza riparia, Lannea edulis and Rhynchosia komatiensis. These species are accompanied or soon followed by small trees like Lannea discolor, Combretum gueinzii, Acacia ataxacantha, Dichrostachys cinerea subsp. nyassana, Euclea crispa, Rhus rehmanniana, Maytenus heterophylla, Pterocarpus rotundifolius and Heteromorpha trifoliata. The sometimes heavy growth of epiphytic fruticose lichens, e.g. species of Ramalina and Usnea, in the crowns of the above trees furnishes evidence of the frequent occurrence of mist.

Confined to and rooted in crevices in the rock, together with most of the associated undergrowth, the trees thicken up to form a type of woodland. Under this woodland, drifts of leaves and other litter accumulate in places to form an adequate substratum for species like Eulophia streptopetala and Kalanchoe rotundifolia, where the litter is not too deep. Elsewhere, much of the rock remains exposed.

The associated undergrowth consists mainly of the following:

Small Trees:

Maytenus heterophylla	Canthium inerme
Euclea crispa	Combretum gueinzii
Canthium huillense	Cussonia spicata
	Ficus petersii

Shrubs:

Iboza riparia, *Cassia laevigata and Lippia javanica.

Low, Soft Shrubs, Undershrubs and Tall Subwoody Forbs:

Fadogia monticola	Triumfetta rhomboidea
Pavonia columella	Justicia cheiranthifolia
Triumfetta pilosa var. effusa	Diospyros lycioides subsp. sericea

Grasses and Sedges:

Cyperus albostriatus associated with Hyparrhenia hirta, with occasional H. gazensis, Setaria chevalieri and S. flabellata.

Low Forbs and Ferns:

Gerbera glandulosa and Pellaea viridis, with occasional Asparagus africanus, Eulophia streptopetala and Kalanchoe rotundifolia.

As in the case of the rock mat formation, these earlier lithoseral stages on broken rock of the xeroclines in the Lower High Forest Zone are remarkable for the presence of several Low-Country elements, e.g. Dichrostachys cinerea subsp. nyassana, Ficus petersii, Lannea discolor,

Plate 27. Parinari curatellifolia subsp. mobola Consocies on steep, broken northwestern slopes of Piesang Kop, Christinasrust.

Pterocarpus rotundifolius and Rhynchosia komatiensis. The Low-Country impress of the vegetation persists to some extent in the later stages as, for instance, in the presence of Combretum zeyheri in the Parinari curatellifolia subsp. mobola Consocies described below.

(b) Parinari curatellifolia subsp. mobola Consocies. On the northwestern slopes of Piesang Kop, at an altitude of about 1275 m where the granite-gneiss bedrock is broken into large blocks, a consocies of Parinari curatellifolia subsp. mobola has developed (see Plate27). Its xerophytic character is understandable in view of the steep well-drained rocky surface of northwesterly aspect under rain-shadow conditions.

(i) Structure and Composition. In structure, this is an open scrubby community. Though not clearly stratified it can, for convenience of description, be divided into the following synusiae on the basis of height and woodiness.

Dominant Tree Layer. Rooted in the crevices of the rock, abundant small trees, about 4 m to 5 m tall, are present, among which Parinari curatellifolia subsp. mobola predominates. Also present are Combretum gueinzii, Faurea speciosa, Acacia ataxacantha, Brachylaena transvaalensis, Euclea crispa, Rhus rehmanniana and R. chirindensis forma legatii, together with Combretum zeyheri, as a rare Lowveld Sour Bushveld element.

Shrub Layer. This stratum is largely represented by transgressive small trees, including Canthium huillense and C. inerme, with occasional transgressive Acacia ataxacantha and Fagara davyi.

Field Layer. The field layer is conveniently dealt with if subdivided into three sublayers as follows:

Low Soft Shrubs and Suffrutices. The most abundant of these is Hemizygia rehmannii, accompanied by Iboza riparia, Rhynchosia angulosa, Indigofera swaziensis, Aeschynomene rehmannii var. leptobotrya, Conostomium natalense var. glabrum, Justicia cheiranthifolia, Athrixia phylicoides, *Cassia laevigata and Cineraria fruticetorum.

Grasses and Sedges. The more abundant grasses and sedges include Loudetia simplex, Schizachyrium semiberbe, Trachypogon spicatus, Eragrostis curvula, Andropogon amplectens and Cyperus albostriatus.

Forbs and Ferns. More or less frequent in this subclass are *Eupatorium africanum*, *Scilla natalensis*, *Crassula rubicunda*, *Pellaea calomelanos*, *P. viridis*, *Selago natalensis*, *Vellozia villosa*, *Callilepis salicifolius*, *Fadogia monticola*, *Gerbera jamesonii*, *Gladiolus* sp., cf. *G. crassifolius*, *Kalanchoe rotundifolia*, *K. thyrsiflora*, *Pteridium aquilinum*, *Triumfetta pilosa* var. *effusa* and *Vernonia natalensis*, with occasional *Acalypha wilmsii* and *Vernonia hirsuta*.

Lianoid Plants. Scandent plants are poorly represented. Lianes present are *Adenia gummifera*, *Clematis brachiata* and *Canthium gueinzii*. Also present are the lianoid subwoody forb *Cryptolepis oblongifolia* and the slender twiner *Abrus fruticulosus*.

Epiphytes. The only epiphytes observed were abundant epiphytic lichens, notably species of *Usnea* and *Ramalina*, particularly on the dominant.

(ii) Ecological Notes. The stages preceding this community were probably subject to some grazing and browsing by Bantu-owned livestock, especially goats, so that this stand can probably be regarded as secondary, at least in part. Lower downslope to the northwest and west-northwest, the terrain becomes steeper and more broken with great blocks of rock and boulders lying in steep irregular steps with deeper and wider crevices between them. Here the *Parinari curatellifolia* subsp. *mobola* Consocies thickens up and becomes more mesophytic with the inclusion and progressive increase downwards of *Ficus capensis*, *Euclea crispa* and **Jacaranda mimosifolia*. Associated plants include *Cineraria fruticetorum*, *Gerbera glandulosa*, *Agapanthus inapertus*, *Hypoxis rigidula*, *Setaria sphacelata*, *Dryopteris* spp. and many more. This more mesophytic mixed community grades into the scrub forest and scrubby forest (e.g. *Ficus capensis* - Other Species Associes , see p. 130 *et seq.*) of the kloofs in the High Scrub Forest Zone.

(2) Mesoclinal Lithoseres.

(2.1) Rock Mat Formation. The only stages of mesoclinal rock mat formation noted are located on a sloping sheet of granite-gneiss on the eastern bank of the main western tributary of the Modyetsi Stream on the southern slopes of Piesang Kop, between about 1150 m and about 1200 m elevation.

Habitat. The site is misty in low cloud and wet weather.

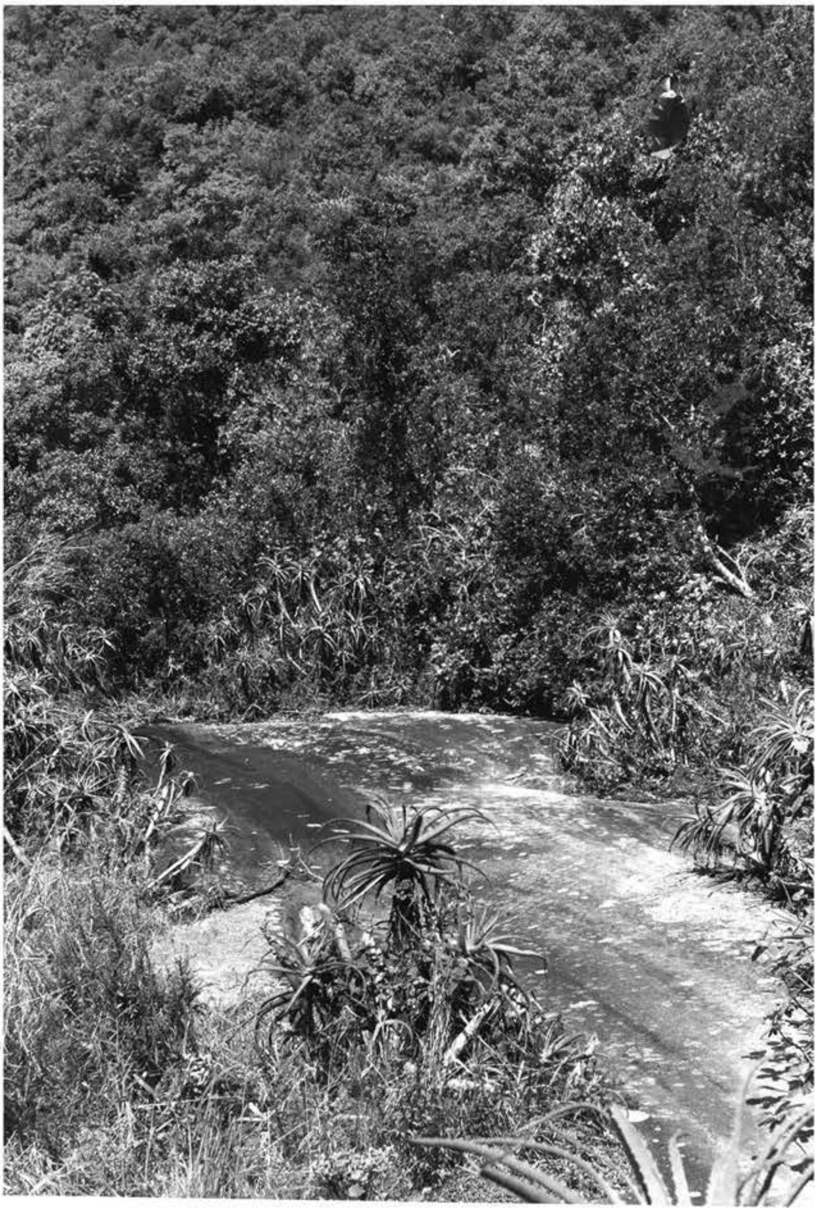

Plate 28. Mesoclinal rock mat formation, Piesang Kop. Upper portion, looking downslope. In foreground: Aloe arborescens and Greyia radlkoferi.

The rock face is exposed to intense sunshine at midday in sunny weather in midsummer, becoming hot and very dry at such times. Otherwise, it is lightly shaded, damp and cool (to cold in winter) with heavy dew condensation. After wet and foggy weather, the rock surface remains moist for a considerable length of time, the glistening moisture giving the appearance, from a distance, of running water. The rock face slopes steeply to the south and is sheltered from all except southerly winds.

Two microhabitats can be differentiated, viz. a more mesic habitat towards the rivulet on the west and a more xeric habitat towards the west-facing rock bank on the east. The initial stages of succession in these microhabitats are essentially similar, however.

(i) Initial Stages. The succession is initiated by lichens, especially foliose lichens, notably species of *Parmelia*, with occasional fruticose *Anaptychia leucomelaena*, followed by the fruticose *Cladonia* sp., where there is some accumulation of soil. At this stage, the seres diverge towards the mesic to the west and the more xeric to the east. The sign ↓ in parentheses behind a name indicates that the species concerned is more frequent in the lower portion of the rock sheet. The lower portion is sunnier but receives more run-off water.

(a) Moister Situations near Water. *Cladonia* sp. and other lichens are accompanied or succeeded at an early stage by colonies of large mosses forming deep extensive pure stands, viz. species of *Rhodobryum* and *Campylopus*, the latter especially in large masses around the bases of *Aloe arborescens* stems.

The deep carpets of mosses sometimes act as seed-beds for vascular plants. Higher plants are, however, also able to colonise lichen mats and even small crevices and depressions in the rock surface direct, especially where there is some accumulation of inorganic and organic debris. Such vascular pioneers are given below, roughly in order of their appearance:

Peperomia retusa (in shade)
Crassula rubicunda
Kalanchoe rotundifolia
Justicia protracta
Plectranthus arthropodus
Setaria chevalieri
Aloe arborescens (see Plate 28)
Asplenium aethiopicum
A. splendens
Cineraria fruticetorum

Greyia radlkoferi
Curtisia dentata
Cussonia spicata
Myrica pilulifera
Nuxia congesta
Maesa lanceolata
Pittosporum viridiflorum
Rapanea melanophloeos
Smilax kraussiana
Syzygium cordatum

In addition to the woody plants mentioned in the right-hand column, occasional _Cussonia umbellifera_, _Nuxia floribunda_ and _Strelitzia caudata_ occur near to the rivulet. Other woody plants are the lianes _Canthium gueinzii_, _Dalbergia armata_ and _Secamone alpinii_. _Strelitzia caudata_ and the above trees, especially the more mesophytic species such as _Cussonia umbellifera_ and _Syzygium cordatum_, with the addition of _Harpephyllum caffrum_, are more numerous on the steeper, more broken western bank of the rivulet with more soil. Where drifts of litter are absent on the steepest parts of the western bank, especially where there is an overhang, the extremely localised (cf. p.99) _Selaginella mittenii_ may occur in small pure stands. The tendency of this type of waterside community of woody plants is to develop _via_ a riverine type of scrub forest (cf. p.149 _et seq._) into a type of riverine forest (cf. p.182-8) with the accumulation of more soil. Characteristic associated herbs and ferns of the more mesic intermediate scrub and scrub-forest stages include _Satyrium parviflorum_, _Cheilanthes hirta_ and _Mohria caffrorum_. Farther away from the creek, this sere converges on the later stages of the drier mesoclinal lithosere discussed below.

(b) _Drier Situations away from Water_. _Cladonia_ sp. and other lichens are joined by several mosses at an early stage, carpeting bare rock and colonising mats of crustose lichens. Such mosses are, for instance, _Haplocladium angustifolium_ (♆), _Papillaria africana_, _Trachyphyllum gastrodes_ (♆), _Braunia secunda_ and _Leucodon maritimus_. The mosses, especially the first three mentioned, form small to sometimes fairly extensive mats which, when they have accumulated sufficient soil and plant material, are colonised by vascular plants, such as the more or less herbaceous species set out below, roughly in order of their abundance and their entry into the sere:

Cineraria fruticetorum	_Conostomium natalense_ var.
Kalanchoe rotundifolia	_Plectranthus arthropodus_
Pellaea calomelanos (occasional)	_Cassinia phylicaefolia_
P. viridis	_Cymbopogon validus_
Aloe arborescens	_Loudetia simplex_
Crassula rubicunda	_Melinis minutiflora_
_Erica woodii var. robusta_*	_Panicum maximum_
Helichrysum lepidissimum	_Rhynchelytrum repens_
H. polycladum (very localised)	_Setaria chevalieri_
Justicia protracta	_Pteridium aquilinum_
	Smilax kraussiana

The foregoing are joined at an early stage by woody pioneers including

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* Type locality of variety (Dulfer, 1963).

Plate 29. West-facing rock bank on eastern bank of main western tributary of Modyetsi Stream, on southern slopes of Piesang Kop. Ficus ingens with Aloe arborescens, Greyia radlkoferi, Setaria chevalieri and Syzygium cordatum.

Ficus ingens (which can colonise bare rock crevices, see Plate 29), fairly frequent Combretum kraussii, Nuxia congesta, occasional Acacia ataxacantha, Canthium inerme, Rhus chirindensis forma legatii, Rhynchosia clivorum and Syzygium cordatum, accompanied by creeping Smilax kraussiana and species of Usnea and Ramalina among the epiphytic lichens.

The first woody pioneers are accompanied or succeeded, especially where the rock surface is more seamed, jointed and broken and where there is greater soil accumulation in the crevices, by Myrica pilulifera, Scilla natalensis, Cheilanthes hirta, Agapanthus inapertus and Anthospermum ammanioides, together with occasional Stoebe vulgaris (very localised), Selago natalensis, Canthium huillense, Cephalanthus natalensis, Bridelia micrantha, Nuxia floribunda, Protea rhodantha, Rapanea melanophloeos and Strelitzia caudata. There are simultaneous increases of Nuxia congesta and Syzygium cordatum, with Smilax kraussiana spreading to cover extensive areas. The further succession after this stage would appear to converge on the Smilax kraussiana - Helichrysum odoratissimum - Carex spicato-paniculata - Pteridium aquilinum Continuum (see p. 169 et seq.) of the lithosere on seamed to broken rock.

(2.2) Lithosere on Seamed to Broken Rock. A series of seral stages on seamed and jointed rock is found a short distance upslope of those of the rock mat formation, under the western portion of the summit of Piesang Kop, between about 1225 m and 1250 m elevation.

(a) Early Stages. Primary bare areas are somewhat seamed and jointed sheets of granite-gneiss lying at the base of a slope occupied by the earlier stages of this sere.

(i) Habitat. In several respects, the habitat resembles that of the rock mat stages just described but the slope to the south is more gentle. This site possibly experiences somewhat more mist but it is exposed to much more intense sunshine for longer periods as well as being very much more exposed to wind. The site is thus very much more liable to extreme desiccation at all times of the year and to high temperatures in the warmer months.

As far as the early stages are concerned, two main microhabitats can be differentiated, viz. the small crevices and depressions in the rock surface and the larger seams and joints. The pioneers typically colonising these microhabitats also differ somewhat.

(ii) Composition. Pioneers of small crevices and the outer edges of colonised seams, roughly in that order and the order of their establishment, are mosses, Pellaea viridis, Mohria caffrorum, Pteridium aquilinum, Pellaea quadripinnata, Cyanotis nodiflora, Commelina diffusa, Crassula rubicunda, Argyrolobium adscendens, Justicia protracta, Helichrysum odoratissimum, H. lepidissimum, H. adscendens, Anthospermum herbaceum, Athrixia phylicoides and numerous grasses, especially Loudetia simplex. Other grasses are Cymbopogon validus, Setaria sphacelata, Rhynchelytrum repens, Schizachyrium semiberbe, Andropogon eucomus and Eragrostis curvula, with the grass-like Hypoxis angustifolia, together with the forbs Triumfetta pilosa var. effusa, T. rhomboidea and Tephrosia shiluwanensis.

Fairly frequent in the early stages of succession along the larger joints are Erica woodii (var. robusta?), Cassinia phylicaefolia, Senecio junodii, S. isatideoides, Cineraria fruticetorum, Helichrysum nudifolium var. quinquenerve, Aristea ecklonii, Hibiscus sp., cf. H. aethiopicus var. ovatus and Smilax kraussiana. These more herbaceous species are followed by such shrubs and suffrutices as Rhynchosia clivorum, Tephrosia zombensis, Helichrysum umbraculigerum, H. chrysargyrum, Clutia affinis and Lippia javanica. Also present is the hemiparasitic, hemi-epiphytic twiner Cassytha ciliolata, together with Jasminum streptopus var. transvaalense, twining and scrambling over the foregoing species.

Small trees and scramblers may begin to invade the joints at this stage. These include Canthium inerme, Cussonia spicata, Nuxia floribunda, Brachylaena transvaalensis, Combretum kraussii, Rhus chirindensis forma legatii, Curtisia dentata, *Psidium guajava, Rhus intermedia, Pittosporum viridiflorum, Myrica pilulifera, Maesa lanceolata, Halleria lucida, Syzygium cordatum, Apodytes dimidiata and Nuxia congesta.

(b) Smilax kraussiana - Helichrysum odoratissimum - Carex spicato-paniculata - Pteridium aquilinum Continuum. This heterogeneous "community" is a tangled rank scrubby grassveld on a spur below the western portion of the summit of Piesang Kop, between about 1250 m and about 1275 m elevation.

(i) Habitat. This site is exposed to the sun at practically all times of the day throughout the year, and to most winds except those from a northerly to northeasterly direction. Although much cooler during the winter and in misty and wet weather, it is mostly warm to hot, owing to the gentle to moderate slope (mainly between 10° and 15° from the horizontal), the aspect being about 25° east of south.

The substratum is well drained and aerated to dry. The soils vary somewhat between the top and bottom portions. The soils of the lower portion are shallow to mostly fairly deep, humiferous friable sandy loam or loam over granite-gneiss with diabase boulders, becoming more humiferous and granular upwards. There is little evidence of erosion and run-off except for the lowermost portion abutting on the seamed rock pavement mentioned on p. 168. Infiltration is facilitated by the uneven soil surface resulting from biotic factors such as routing by bush pig and the burrowing of "moles"*. The soil of the upper portion is typically fairly deep, humiferous friable granular loam over granite-gneiss and diabase with a usually deep accumulation of litter and duff. There appears to be little or no erosion: infiltration is probably good with very little or no run-off except after exceptionally heavy downpours.

(ii) Structure and Composition. The structure and species composition change considerably from top to bottom. The general aspect of the upper portion is imparted by woody plants, tall suffrutices and herbs. The lower portion is somewhat more open in facies, the lowermost portion being dominated (cover) by *Smilax kraussiana* with suffrutices and scattered trees. Different synusiae can be distinguished more or less easily and these will be dealt in order of relative importance. The signs ↑ and ↓ in parentheses after names signify whether the species concerned tend to be more abundant in the upper or lower portions respectively.

Herbaceous and Subwoody Forbs and Suffrutices (up to about 1 m tall). This synusia is conveniently regarded as one entity. The codominant species of this height class are codominant or subdominant in the stand as a whole, viz. the suffrutescent forb *Helichrysum odoratissimum* (↓), the sedge *Carex spicato-paniculata* (↓) and the bracken fern *Pteridium aquilinum* (↓). The following associated plants are far less abundant:

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* i.e. Golden moles or mole-rats or both.

Senecio junodii
Plectranthus calycinus
Erica woodii (var. ?)
Hyparrhenia cymbaria (↑)
Phyllanthus nummulariaefolius (↓)
Anthospermum herbaceum (↓)
Helichrysum umbraculigerum (↓)
Mohria caffrorum (↓)
Schistostephium heptalobum (↑)
Tephrosia zombensis (small) (↑)
Pellaea viridis (↓)
Senecio isatideoides (↓)
Endostemon obtusifolius (↑)
Tephrosia shiluwanensis (↓)
Helichrysum nudifolium var. (↑)
Cassinia phylicaefolia (↓)
Indigofera schinzii
Cymbopogon validus (↓)
Cyperus albostriatus (↑)
Eriospermum cooperi
Paspalum commersonii (↓)
Pellaea quadripinnata (↓)
Setaria sphacelata (↑)
Aster peglerae
Athanasia punctata
Conostomium natalense var.
Helichrysum chrysargyrum (↓)
Nidorella auriculata
Helichrysum platypterum
Pavonia columella
Senecio pandurifolius
Asparagus virgatus
Cyanotis nodiflora
Cyphia elata
Eucomis undulata
Haemanthus magnificus
Helichrysum adscendens
Hyparrhenia gazensis
Littonia modesta
Vernonia hirsuta
Helichrysum wilmsii (rare)

Shrubby Plants (1 m to about 2 m tall). Shrubby plants do not in any way dominate the general aspect but, in the aggregate, a number of species contribute much to the stand. These include Vernonia corymbosa, Rhynchosia clivorum (↓), Clutia affinis, Rhoicissus tridentata, Lippia javanica and Hypericum revolutum, with occasional fully grown Tephrosia zombensis and Lantana mearnsii.

Trees (above 2 m tall). The most abundant of the invading trees, especially in the upper portion, appears to be Euclea crispa. With it are associated Rhamnus prinoides (↑), Heteromorpha trifoliata (↑), Halleria lucida, Combretum kraussii (↓) and Protea rhodantha (↑) with scattered Brachylaena transvaalensis, Curtisia dentata, Heteropyxis natalensis, Maesa lanceolata, Myrica pilulifera, Nuxia congesta, N. floribunda, Rapanea melanophloeos, Rhus intermedia and Trimeria grandifolia.

Ground Layer. A ground layer is very poorly developed, consisting of local aggregations of mosses on rocks and soil, e.g. Rhodobryum sp., Entodon dregeanus, Campylopus purpurascens (↓) and Ptychomitrium eurybasis (↓, on diabase outcrop).

Lianoid Plants. In conformity with the absence of a closed canopy and the lack of differentiation of climbing plants on a height basis, scandent and subscandent plants are dealt with as one entity. The predominant lianoid plant and dominant plant for the whole continuum in cover, if not in numerical abundance of individuals, is Smilax kraussiana. It appears to be more abundant in the bottom portion of the glade where it is present in such quantity as to render the "grassveld" practically impenetrable. Far less abundant are Cephalanthus natalensis (♥), Sphedamnocarpus galphimiifolius (♠), Rhynchosia caribaea, Adenia digitata, Choristylis rhamnoides, Rubus pinnatus, Dalbergia armata and Stephania abyssinica. Rhamnus prinoides seldom scrambles in this stand.

Parasites. Except for Smilax kraussiana, the hemiparasitic more or less epiphytic twiner Cassytha ciliolata is the most abundant lianoid plant, also contributing towards the impenetrability of the community. The root parasites Harveya coccinea and H. speciosa occur only infrequently to rarely.

(iii) Ecological Notes. The succession in the continuum appears to be towards a more dense and closed scrub. The trend in the lower portion is towards a thickening up of the open scrub with the increase of the following woody plants:

Rhus intermedia	Canthium inerme
Euclea crispa	Maesa lanceolata
Nuxia floribunda	Maytenus heterophylla
Acacia ataxacantha	Rapanea melanophloeos
Rhamnus prinoides	Rhus rehmanniana
Rhus transvaalensis	Bridelia micrantha
Myrica pilulifera	Curtisia dentata
Rhus chirindensis forma	Heteromorpha trifoliata
Combretum kraussii	Heteropyxis natalensis
Halleria lucida	Nuxia congesta
Pittosporum viridiflorum	Protea rhodantha

The lower portion thus seems to be trending in the direction of the present composition of the upper portion.

The upper portion is developing in the direction of a more closed scrub community dominated by Euclea crispa. Associated species are likely to be Rhus intermedia, R. transvaalensis, Rhamnus prinoides, Acacia ataxacantha, Heteromorpha trifoliata, Pittosporum viridiflorum, Maytenus heterophylla and Trimeria grandifolia with occasional Halleria lucida, Nuxia floribunda, Protea rhodantha, Rapanea melanophloeos, Rhus chirindensis forma legatii and R. rehmanniana. The upper portion thus appears to be developing into a Euclea crispa Consocies or E. crispa - Other Species Associes comparable with that described below.

(c) Euclea crispa - Other Species Associes. On the western edge of the continuum just described, a closed scrub community has developed. It is also situated on a south-facing slope under the western part of the summit of Piesang Kop, at an altitude of about 1250 m. This community merits brief description as an example of a primary *E. crispa* - dominated community in the Lower High Forest Zone (cf. p.48-51, Appendix A).

(i) Structure and Composition. In most parts, there are only six synusiae present, although more are represented in the community as a whole. Only the most characteristic and conspicuous species are mentioned in the following description.

Canopy (mainly about 4 m to about 6 m in height). The more typical canopy components include *Euclea crispa*, *Pittosporum viridiflorum*, *Acacia ataxacantha*, *Combretum kraussii*, *Maesa lanceolata*, *Maytenus heterophylla*, *Rhus chirindensis* forma *legatii* and *R. intermedia*.

Understory (2 m to about 3.5 m in height). *Canthium inerme*, *Trimeria grandifolia*, *Allophylus transvaalensis* and *Heteromorpha trifoliata* tend to form an understory in places, associated with transgressive canopy species.

Shrub Layer (about 1 m to about 2 m tall). Apart from transgressive small trees, this height class is poorly represented and discontinuous. True shrubby plants comprising this stratum are *Carissa bispinosa* var. *acuminata*, *Endostemon obtusifolius*, undersized *Maytenus mossambicensis* var. *mossambicensis*, *Peddiea africana*, *Rhoicissus tridentata*, *Vernonia ampla* and *V. corymbosa*.

Field Layer (up to about 1 m in height).

Low Soft Undershrubs and Tall Subwoody Herbs and Ferns. The most characteristic species in this subclass are *Anthospermum herbaceum* and *Tephrosia shiluwanensis*, together with *Argyrolobium tomentosum*, *Asparagus virgatus*, *Athanasia punctata*, *Athrixia phylicoides*, *Cineraria fruticetorum*, *Desmodium repandum*, *Pavonia columella*, *Pteridium aquilinum*, *Schistostephium heptalobum*, *Senecio pandurifolius*, *S. junodii*, *Stachys grandifolia* and *Vernonia hirsuta*.

Low Soft Herbs and Ferns. The constituents of this sublayer are infrequent with the exception of *Oplismenus hirtellus*, which dominates the floor, the subdominant *Carex spicato-paniculata* and *Galopina circaeoides*. Associated plants include *Commelina diffusa*, *C. eckloniana*, *Cyperus albostriatus*, *Setaria* chevalieri, S. sphacelata, Helichrysum nudifolium var. quinquenerve, Pellaea viridis and Achyranthes aspera.

Lianoid Plants. The more robust lianes and scramblers capable of reaching the "canopy" include Smilax kraussiana, Sphedamnocarpus galphimifolius, Jasminum streptopus var. transvaalense, Rhamnus prinoides, Rhoicissus tomentosa, R. rhomboidea, Canthium gueinzii, Dalbergia armata, Asparagus falcatus, Cephalanthus natalensis, Clematis brachiata, Rubus pinnatus, Secamone alpinii, S. gerrardii and Vernonia mespilifolia.

Soft slender climbers are poorly represented compared with the more woody robust lianoid plants. Among the more important species are Rhynchosia caribaea, Adenia digitata, Behnia reticulata, Cissampelos torulosa, Asparagus asparagoides and Dolichos lablab.

Epiphytes. Only the epiphytic ferns Pleopeltis macrocarpa and Polypodium polypodioides subsp. ecklonii occur fairly frequently. The orchid Polystachya ottoniana may also grow here and there.

Parasites. The root parasite Harveya coccinea is rare in this community.

(iii) Ecological Notes. This community shows affinities with the secondary Euclea crispa-dominated community of the Middle High Forest Zone (see p.48-51, Appendix A). This stand appears to be changing in the direction of a very mixed scrub-forest associes with the addition of several tree species, including Brachylaena transvaalensis, Bridelia micrantha, Celtis africana, Cussonia spicata, Nuxia congesta, N. floribunda, Rapanea melanophloeos, and Scolopia zeyheri.

(2.3) Lithosere on Cliff and Talus Slopes. Little can be asserted concerning the course of succession on cliff faces and the scree below. The only seral stage seen on this type of habitat was an advanced "cliff forest" on the south-facing slopes of the kloof of the upper Mtataspruit, i.e. the craggy slopes opposite to the talus slopes serving as the habitat of the Drypetes gerrardii Consocies of the High Scrub Forest Zone (see p.119 et seq.).

Nuxia floribunda - Other Species Associes. This "cliff forest" is practically inaccessible and impenetrable owing to the steep

Plate 30. View of cliff forest merging into more normal montane high forest towards the skyline.

bouldery slope and the wealth and luxuriance of lianoid plants. The following description is based on three "transects", from top to bottom at right angles to the contours, roughly scanned with the aid of a telescope from a vantage point near the top of the steep slopes on the opposite side of the kloof.

(a) Habitat. The cliff forest surveyed reached from a level of about 1200 m at the bottom where it merges into the upper portion of the kloof forest, i.e. the postclimax *Cussonia spicata - Ficus capensis* Association of the High Scrub Forest Zone (see p. 141-7*et seq.*), to about 1275 m to 1300 m elevation at the top, where it grades into fairly typical montane high forest of the Lower High Forest Zone. This steeply sloping site is exposed to direct sunlight only in the early part of the day in midsummer. For the rest, the local climate is shady, damp and cool to cold. The cliff is sheltered from winds except for the stronger winds from the east and, to a lesser extent from the south. In view of this sheltered position, mist is probably less frequent than is usual in this zone, although the upper reaches do experience mist quite frequently.

The substratum consists of much-jointed and broken granite-gneiss with a small apron of scree at the base of the steeper slopes near the head of the kloof. These blocks of bedrock have caught up shallow accumulations of rock fragments, litter and duff, especially in the joints and crevices, which are often deep and where the trees are mostly rooted. Further discussion of the habitat follows under (iii) Ecological Notes below (p.177-8).

(b) Structure and Composition. The trees are widely and rather irregularly spaced in joints and crevices between the almost solid to loose granite-gneiss blocks. The "canopy" is open, irregular and very uneven as far as the crowns of the trees are concerned but the trees are more or less bound together by a continuous cover of lianoid plants which form a "closed canopy". The community can thus almost be regarded as closed (see Plate 30).

Stratification is practically absent. Only two or three synusiae can usually be seen at any one place. More synusiae are present although some are scarcely represented as can be seen below.

(i) Large Trees. This synusia is dominated by *Nuxia floribunda*, *Kiggelaria africana* (especially on the lower, more sheltered parts of the slope) and *Cryptocarya liebertiana* (particularly on the upper, more exposed levels). Associated with the dominants are

Brachylaena transvaalensis, Cussonia spicata, Trichilia dregeana, Celtis africana, Combretum kraussii, Rapanea melanophloeos and occasional Croton sylvaticus, Ficus capensis, Nuxia congesta and Rhus chirindensis forma legatii, with isolated Syzygium gerrardii in the uppermost portions.

(ii) Small Trees. The more abundant fully grown small trees are Aphloia theiformis and Dombeya burgessiae, accompanied by occasional Maytenus mossambicensis var. mossambicensis and Tricalysia capensis.

(iii) Shrubs. True shrubs are poorly represented, being confined to places not covered by creepers or already occupied by trees. The most numerous species present is Plectranthus fruticosus with occasional Peddiea africana and Sclerochiton harveyanus.

(iv) Herbaceous Plants. This class is very poorly developed being represented only where the overwhelming lianoid plants do not cover an unoccupied niche. Among such plants, the saxicolous Begonia sonderiana has been noted to occur on the lower talus slopes as has the robust mesophytic fern Ctenitis lanuginosa.

(v) Ground Layer. This stratum appears to be poorly represented like the previous class and for the same reason. Mosses and Jungermanniales seem to grow only sporadically on exposed rocks. Occasional thallose liverworts also grow on exposed rock surfaces, especially in the lower portions near seepages from joints.

(vi) Lianoid Plants. This life form is abundantly represented, covering all the spaces between the trees with a practically continuous sheet of foliage. The limitations implicit in the method of survey, viz. observation from a distance by means of a telescope supplemented by observations on and from the talus slopes, must be borne in mind in reading the following description. In view of the lianoid plants making up the bulk of the "canopy", which varies greatly in vertical height above the substratum, regardless of whether the individual components are robust or not, it would be impracticable to further subdivide the lianoid plants. The dominant species of this synusia, if not of the community as a whole, seems to be Adenia gummifera. Adenia gummifera appears to be dominant in abundance, if not in cover, and is associated with the following more or less abundant species:

Coccinia variifolia	Mikania cordata
Rhoicissus tomentosa	Entada spicata
Cephalanthus natalensis	Cyphostemma anatomicum
Ceratiosicyos laevis	Ipomoea wightii
Cissampelos torulosa	Riocreuxia torulosa
Rhoicissus revoilii	Rubus pinnatus
R. rhomboidea	Scutia myrtina
Canthium gueinzii	Solanum bifurcum
Senecio tamoides	Vernonia mespilifolia

(vii) Epiphytes. Although it was not possible to identify the epiphytes with certainty, epiphytic plants were noted especially on Cussonia spicata, which appears to be better able to pierce the canopy of lianoid plants and to carry its crown well above the general canopy level, than most other tree species. The vascular epiphytes present probably include species of Peperomia, Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana, together with occasional Asplenium rutaefolium.

(c) Ecological Notes. The differences between the cliff forest described above and the Drypetes gerrardii Consocies of the opposite slope (see p.119 et seq.) are very striking. These differences can be attributed to environmental differences (cf. p.119-20 & 121-22, and 175 & 177, below). The local climatic and edaphic factors are discussed generally under the head (a) Habitat (see p.175). Moisture factors are favourable. The rainfall is relatively heavy and supplemented by much seepage down joints and between crevices. Evapotranspiration is generally low owing to low temperatures, high humidity and shelter from desiccating winds. Although moisture relations are favourable for deep-rooted plants once they have become established, the establishment of young plants in this community is understandably difficult. Limiting factors are the lack of rooting space and the danger of being smothered and shaded out by lianoid plants. Low temperatures causing slow growth of the more tropical species may limit them through liability to smothering.

The stand gives the impression of being relatively stable for the most part. It is apparently in equilibrium with its habitat which is rather unstable because of periodic rock falls, rock slides and other shiftings in the rock mass. Nevertheless, to judge by the young potentially taller trees present, minor changes in species composition are likely to take place. The future tree flora will probably include the following more conspicuous species:

Kiggelaria africana	Rhus chirindensis forma
Nuxia floribunda	Aphloia theiformis
Brachylaena transvaalensis	Combretum kraussii
Celtis africana	Fagara davyi
Cryptocarya liebertiana	Nuxia congesta
Cussonia spicata	Rapanea melanophloeos
Trichilia dregeana	Tricalysia capensis
Bersama sp., cf. B. transvaalensis	Croton sylvaticus
Dombeya burgessiae	Ficus capensis
Ochna holstii	Maytenus mossambicensis var.
	Syzygium gerrardii (scattered)

2. THE CLIMAX (OR SUBCLIMAX):

TRICHILIA DREGEANA-CUSSONIA SPICATA-CRYPTOCARYA LIEBERTIANA ASSOCIATION

The only stand investigated in the Lower High Forest Zone which is considered to approach a climax condition is a somewhat scrubby forest on a rocky ridge a short distance to the east of the main western tributary of the Modyetsi Stream on the southern slopes of Piesang Kop between about 1200 m and about 1250 m elevation.

2.1 HABITAT

The site slopes more or less to the south-southwest, the slope varying a great deal but probably averaging about 20° from the horizontal. The forest occupies an elongated strip bounded on the west by riverine scrub forest (see p.149-51), and on the east by a diabase dyke outcrop with which the ridge is surmounted. The ridge is somewhat exposed to wind and sun (in summer) from the east and, especially, from the west, as well as to winds from the south. The mean annual precipitation and the incidence of mist are fairly high. Owing to the protection afforded by the ridge, mist tends to be dispelled rather later than at the same level farther to the east. The climate is generally cool to rather cold but frost-free in winter to warm in summer.

The bedrock towards the creek consists of seamed granite-gneiss, with diabase rocks and boulders increasing towards the dyke forming the crest of the ridge. The soils are immature ferrallitic clay loams, sometimes very shallow, moderately to very humiferous with a shallow to deep mulch of duff and litter. Although the rainfall is probably fairly heavy and the incidence of mist fairly high, the site is well drained to dry. The seasonal drought is tempered by reduced evapotranspiration in winter but it may be very severe in spring and early summer, at least in some years.

2.2 STRUCTURE AND COMPOSITION

The stand has a closed canopy of rather irregularly spaced tall trees, often with great clear boles and large spreading crowns. The undergrowth is also rather irregular in distribution and fairly open, on the whole, apparently owing to suppression, probably more through root competition than lack of light. As a result, stratification is not pronounced although several synusiae are represented, as set out below:

(A) OVERSTORY

No clear emergents were encountered in sampling this stand but emergent *Homalium dentatum*, *Trichilia dregeana* and other tall-growing trees may well be present.

(B) CANOPY

The canopy is uneven, ranging up to 18 m or more in height. It appears to consist largely of *Trichilia dregeana*, *Cussonia spicata*, *Cryptocarya liebertiana*, *Scolopia zeyheri*, *Celtis africana* (especially towards the creek), *Harpephyllum caffrum*, *Ficus craterostoma*, *Xymalos monospora*, *Syzygium gerrardii* (especially towards the creek) and *Croton sylvaticus* (especially towards the crest of the ridge), with occasional *Apodytes dimidiata*, *Bridelia micrantha*, *Curtisia dentata* (especially towards the edges), *Prunus africana*, *Olea capensis* subsp. *macrocarpa* and *Rhus chirindensis* forma *legatii*.

(C) UNDERSTORY

Apart from fair-sized *Xymalos monospora* which do not reach up to the general level of the canopy where the canopy is high but which can rather be regarded as canopy components, the understory is neither tall nor well-represented, seldom exceeding 5 m in height and being, moreover, discontinuous. It is dominated by *Rawsonia lucida*, associated with large *Carissa bispinosa* var. *acuminate*, *Maytenus mossambicensis* var. *mossambicensis*, *Eugenia natalitia*, *Clausena anisata* and *Rothmannia capensis*, together with occasional *Ekebergia* sp.? (transgressive *E. capensis*?) and *Vangueria infausta*.

(D) SHRUB LAYER

This stratum is poorly developed on the whole and components are seldom more than 2.5 m tall at the most. The dominant shrub is *Piper capense*. It is accompanied by *Peddiea africana* and occasional *Andrachne ovalis*.

(E) FIELD LAYER

The field layer of herbaceous plants up to about 1.5 m in height is poorly represented, both in the numbers of species and in individual plants present. The forest floor is dominated by *Oplismenus hirtellus*, which is accompanied by the suffrutescent *Hypoestes verticillaris* and the ferns *Pteris catoptera* and *Tectaria gemmifera*. *Asplenium rutaefolium*, *A. gemmiferum* and *A. flexuosum** occasionally grow on rocks.

(F) GROUND LAYER

Deep drifts of litter and the well-drained to dry surface soil seem to preclude the development of a ground layer.

(G) LIANOID PLANTS

(1) *Lianes and Scramblers*. The more or less abundant, robust, woody lianoid plants include *Rhoicissus rhomboidea*, *R. tomentosa*, *Canthium gueinzii*, *Cnestis natalensis*, *Scutia myrtina*, *Cyphostemma anatomicum*, *Asparagus falcatus*, *Jasminum streptopus* var. *transvaalense*, *Rhoicissus revoilii* and *Secamone alpinii*, with *Adenia gummifera* especially towards the margin.

(2) *Less Robust, Softer Lianoid Plants*. Far more abundant numerically than the above lianes and scramblers are the slender twiners *Behnia reticulata* and *Tylophora flanaganii*.

(H) HEMI-EPIPHYTIC STRANGLERS

Seedlings and saplings and aerial roots of the younger stages of the hemi-epiphytic strangler *Ficus craterostoma* were noted only infrequently but this species could be more frequent than it would at first appear, in view of the difficulty in seeing young epiphytic plants at any great height.

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* Putative hybrid between *A. gemmiferum* and *A. rutaefolium* (E.A.C.L.E. Schelpe, in lit.)

(I) EPIPHYTES

The difficulties entailed in observing small epiphytic plants precludes any assessment of the absolute or relative abundance of the species present which include Asplenium rutaefolium, Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana among the vascular epiphytes. Numerous smaller epiphytes are probably also present.

2.3 ECOLOGICAL NOTES

The stand is apparently stable. The synusiae constituting the undergrowth are poorly represented in numbers of both species and individual plants and the stand as a whole can almost be described as open. Both these conditions can probably be ascribed to the rocky substratum. Further development towards a richer undergrowth could probably only take place over a very long period with building up of the soil and the weathering of the solid rock which constitutes the bulk of the substratum. Changes in the foreseeable future will probably be limited to changes in the proportions of the numbers of the different species present. These include a possible increase of Cryptocarya liebertiana at the expense of Trichilia dregeana and Cussonia spicata. Other tree species which will possibly become more prominent are Scolopia zeyheri, Rothmannia capensis and Croton sylvaticus. Nevertheless, the tree flora seems to represent a fair approximation of the climax tree flora to be expected at this altitude. This stand provides the closest approximation to the climax of the Lower High Forest Zone on Westfalia Estate.

3. POSTCLIMAX RIVERINE FOREST: SYZYGIUM GERRARDII - OTHER SPECIES ASSOCIATION

The only community of riparian forest investigated in the Lower High Forest Zone is found along the upper Mtataspruit in the vicinity of the boundary between Rosendal and the Grootbosch Government Forest Reserve at about 1275 m elevation.

3.1 HABITAT

This stand lies in a "trough" sloping slightly down to the northeast. The northwestern banks of the stream are fairly level for the most part but the southeastern banks vary from slightly to steeply sloping. The site is sheltered except for wind from between the northeast and the south and for occasional "bergwind"-like westerly winds. Inside the forest, the prevailing microclimates are shady, damp and cool to chilly. There is always abundant to excessive fresh water. The humidity of the atmosphere is attested to by the development of aerial roots (see Plate 32, p. 186) and the abundance of epiphytic bryophytes, e.g. Jungermanniales and Neckeraceae.

The substratum is rocky, mainly granite-gneiss with some diabase, with deep pockets of soil. Soils vary from the better-drained ferrallitic colluvial soils to the saturated colluvial and alluvial hydromorphic soils. Surface litter and duff vary from locally deep to absent on steep slopes where litter moves downwards under gravity. The organic-matter content is variable, but probably seldom very high owing to relatively rapid decomposition and leaching except in hydromorphic soils.

3.2 STRUCTURE AND COMPOSITION

This community has a closed but irregular canopy. Stratification is otherwise fairly well developed for the most part, though some strata may be poorly developed or absent. Some ten synusiae may be distinguished as follows:

(A) OVERSTORY

Emergent trees (17.5 m to 20 m tall or more) are usually absent except for occasional exceptionally tall *Syzygium gerrardii* and *Ficus craterostoma*.

(B) CANOPY

The canopy is irregular in height (8 m to 17 m), often low over the stream where it is frequently composed of the crowns of smaller trees, especially of Xymalos monospora, which commonly occur as understory constituents away from the waterside. In the main, these relatively smaller trees of X. monospora and other species, e.g. Aphloia theiformis, are seldom canopy components. The canopy consists of Syzygium gerrardii (especially near the stream), Cryptocarya liebertiana, Curtisia dentata, Cussonia spicata (crowns often small), Combretum kraussii and Nuxia floribunda, with occasional Brachylaena transvaalensis, Celtis africana, Croton sylvaticus, Ficus craterostoma, Kiggelaria africana, Rapanea melanophloeos and Rhus chirindensis forma legatii. Aphloia theiformis and Trichilia dregeana contribute towards the canopy only rarely here.

(C) UNDERSTORY

This stratum (from about 2.5 m to about 7.5 m in height) appears to be somewhat discontinuous on the whole, an understory proper being locally absent, particularly at the waterside. Apart from transgressive potential canopy trees, especially Xymalos monospora (predominantly along the waterside), understory trees are not remarkably numerous. The more abundant species are Cassipourea gerrardii, fully grown Maytenus mossambicensis var. mossambicensis and Rawsonia lucida, with occasional Dombeya burgessiae, Halleria lucida, Ochna holstii, O. o'connorii, and Tricalysia capensis, with isolated Rinorea angustifolia and very occasional tall Cyathea dregei by the waterside.

(D) SHRUB LAYER

Shrubs (mostly about 2 m to 2.5 m tall) are well represented, the most abundant species being Mackaya bella, Sclerochiton harveyanus and Piper capense. The associated large waterside fern Marattia fraxinea var. salicifolia can also be considered to fall under this height class because of its large fronds and stout woody stem. The foregoing are accompanied by Vernonia umbratica, Plectranthus fruticosus, Carissa bispinosa var. acuminata, Justicia campylostemon and Peddiea africana (mostly rather small), among the more abundant species.

(E) FIELD LAYER

(1) Low Soft Shrubs, Undershrubs and Tall Subwoody Herbs and Ferns (from about 1 m to about 2 m tall). Plectranthus swynnertonii is locally

the most abundant plant in this sublayer in the better-illuminated, more open and more frequently disturbed sites especially near the lower margin. Others among the more or less abundant species include the following:

Pteris catoptera	Stachys grandifolia (disturbed open sites)
Dryopteris inaequalis	Hypoestes verticillaris
Adenocline mercurialis	Blechnum attenuatum
Athyrium scandicinum (waterside)	Dicliptera clinopodia
Tectaria gemmifera	Arachniodes foliosa (=Dryopteris foliosa)
Desmodium repandum (subdued)	Argyrolobium tomentosum (disturbed open sites)
Thelypteris bergiana	Isoglossa cooperi
T. madagascariensis	I. delicatula*
Polystichum ammifolium	Plectranthus laxiflorus
Hypolepis sparsisora (open waterside sites)	Solanum aculeatissimum (" " ")

(2) Low Herbs and Ferns (up to about 1 m tall). Codominant in this sublayer are Clivia caulescens, especially in the darker rocky parts, and Oplismenus hirtellus, scattered more or less throughout the community but particularly abundant in the better-illuminated less rocky parts of the forest floor. Impatiens spp., viz. I. duthieae and I. sylvicola, seem to be subdominant in this sublayer, being especially common in the more open parts of the stream-banks by the waterside. Among the more abundant associated plants is Selaginella kraussiana which grows gregariously but localised in the moister spots. Also among the more or less abundant associated plants are the following species:

Pilea worsdellii (wet places)	Asplenium lobatum
Dietes vegeta	Setaria chevalieri
Sanicula elata (wet, disturbed open sites)	Asplenium inaequaelaterale
Cyperus albostriatus (disturbed open sites)	A. sandersonii
Chlorophytum comosum (disturbed places)	Galopina circaeoides
Asplenium erectum forma	Leidesia procumbens
A. anisophyllum	Peperomia retusa
Crassula thorncroftii	Aristea ecklonii (open better-lit sites)
Asplenium splendens	Crocosmia aurea (" " " ")
A. aethiopicum	Adenostemma perottetii (wet places)
A. gemmiferum	Cardamine africana (disturbed ")
Panicum monticolum	Carex spicato-paniculata (open places)
	Fleurya alatipes (wet, disturbed, open places)

(F) GROUND LAYER

A characteristic species of the ground layer is the liverwort Dumortiera hirsuta on wet rocks by the waterside and in seepage areas.

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* The size, numerical abundance and cover of this species vary cyclically (see under 3.3 ECOLOGICAL NOTES, p. 187).

Plate 31. Luxuriant growth of epiphytes on large specimen of Syzygium gerrardii (carrying large Ficus craterostoma) half-leaning over stream, Rosendal-Grootbosch boundary. Elaphoglossum acrostichoides predominant.

(G) LIANOID PLANTS

(1) Lianes and Scramblers. The more abundant robust and more woody lianoid plants include the following species:

Canthium gueinzii	Asparagus falcatus
Rhoicissus rhomboidea	Jasminum streptopus var.
Entada spicata	Rhoicissus tomentosa
Mikania cordata	Cyphostemma anatomicum
Cephalanthus natalensis	Choristylis rhamnoides
Rhoicissus revoilii	Clematis brachiata
Secamone gerrardii	Cryptolepis capensis
	Grewia occidentalis

(2) Less Robust Lianoid Plants. Of the softer, more slender climbers and stragglers, the most abundant species appear to be Behnia reticulata and Asparagus plumosus. These species are associated with Tylophora flanaganii, Solanum bifurcum, Smilax kraussiana, Coccinia variifolia and Dumasia villosa, with sporadic Dioscorea retusa.

(H) HEMI-EPIPHYTIC STRANGLERS

The canopy or overstory tree Ficus craterostoma typically starts life as an epiphyte, usually quite high up in the crowns of canopy trees. There are probably only a few canopy trees not infested with at least one seedling or "sapling" of this "strangling fig", which may eventually grow to a considerable height with a widely spreading crown, especially after suppressing the supporting plant. The pockets, niches and interstices between the ramified and anastamosed aerial roots provide an abundance of favourable microhabitats suitable for colonisation by epiphytes (see Plate 31).

(I) EPIPHYTES

Epiphytic lichens may be locally abundant in the upper parts of canopy and overstory trees, especially in the more exposed crowns in which fruticose types such as species of Usnea and Ramalina may be locally conspicuous. Foliose lichens, e.g. Pulmonaria species, may occur lower down. Epiphytes are also common below the canopy, especially on the older trees near the waterside, to which the epiphytic Jungermanniales are practically confined. The Neckeraceous mosses Pilotrichella species and Neckera valentiniana are widespread on understory trees and on the boles of taller trees. Also conspicuous is the mat-forming moss Leucoloma rehmannii, which may be locally common (especially on Syzygium gerrardii),

Syzygium gerrardii on banks of upper Mtataspruit, Rosendal-Grootbosch boundary. The small epiphytic moss covering the bark is *Leucoloma rehmannii*.

together with occasional Porothamnium comorense (especially lower down on dead logs and branches).

Besides scattered specimens of Ficus craterostoma of all sizes, the more abundant vascular epiphytes are found among the ferns, viz. the widespread Asplenium rutaefolium and A. sandersonii accompanied by Elaphoglossum acrostichoides (locally abundant but very localised). Associated vascular epiphytes are Asplenium anisophyllum, Clivia caulescens, Peperomia retusa, Asplenium splendens, Polypodium polypodioides subsp. ecklonii, Trichomanes pyxidiferum var. melanotrichum, Asplenium aethiopicum and Streptocarpus parviflorus. Accompanying the foregoing, occasional specimens of species which do not normally grow or reach maturity as epiphytes may be present, e.g. Asplenium erectum, A. inaequaelaterale, Athyrium scandicinum, Cussonia spicata, Dryopteris inaequalis, Plectranthus fruticosus, P. swynnertonii, Vernonia umbratica and even an isolated sapling or two of Rapanea melanophloeos.

(J) PARASITES

The hemi-epiphytic parasitic twiner Cuscuta kilimanjari may also occur locally, especially where the canopy has been opened. It appears to thrive best on Plectranthus fruticosus, Coleus rehmannii, Fleurya mitis and several Acanthaceae.

3.3 ECOLOGICAL NOTES

The trees of the canopy, as well as of the community as a whole, are predominantly evergreen.

Buttressing is a feature of the riverine forest, especially along the waterside zone where the soil is permanently wet to saturated. Buttressed trunks are particularly noticeable in the case of Syzygium gerrardii and, to a lesser extent, of Celtis africana, Cussonia spicata and Trichilia dregeana, and also, superficially, of Ficus craterostoma.

Prop roots and other aerial roots have been observed in Syzygium gerrardii, Ficus craterostoma, Piper capense and also species of Plectranthus, Acanthaceae and other constituents of the undergrowth such as Clivia caulescens. The prop roots of Syzygium gerrardii may become radially flattened, owing to eccentric secondary thickening, and give rise to "flying buttresses" (see Plate 32).

Unusual life forms include that of the tree fern Cyathea dregei, found infrequently along the stream banks where the canopy is more open. The giant fern Marattia fraxinea var. salicifolia is particularly frequent in wet soil. It produces a rosette of large sappy fronds about 2 m long, from a short stout woody stem. Other interesting life forms worthy of note are those of the facultatively epiphytic Clivia caulescens (see p.135) and the more obligate epiphytes.

Of particular interest are the plants identified at present as Isoglossa delicatula, belonging to that section of the genus exhibiting periodic flowering, e.g. I. woodii (Bayer, 1938). Periodic gregarious flowering is quite a well-known feature of tropical forest vegetation, particularly amongst bamboos and species of the Acanthaceous genus Strobilanthes (Richards, 1952; Seifriz, 1920 & 1950 inter alia; Walter, 1962). Isoglossa delicatula is an Acanthaceous undershrub of the Upper Montane High Forests of the Letaba district where it is commonly known as "Kiesieblaar", and reputed to flower only once every decade. While there is much uncertainty concerning the length of time passing between flowering periods it is clear that this species dies down completely after flowering and that the often pure stands developed from this heavy crop of seed grow and spread vegetatively for several years before flowering. The plants grow to a considerable size where not too closely browsed by bushbuck and duiker which are said to relish this species greatly. When the even-aged stands reach the requisite stage of maturity or age, flowering takes place simultaneously over extensive areas. This widespread flowering results in a copious honey-flow benefiting both wild and domestic bee swarms. Bee farmers transport their hives over considerable distances in order to place them strategically close to these nectar sources during "Kiesieblaar" years.

Vegetative propagation is a feature of Dietes vegeta, as has been noted previously. Sometimes the long, lax sprawling to pendant branches of Sclerochiton harveyanus may bend down to and touch ground where they strike root from the nodes. This type of vegetative spread also takes place in other lax Acanthaceous and other shrubs and undershrubs, notably Isoglossa woodii in the later stages of its life-cycle, but it is rarer amongst the more erect species such as Mackaya bella and Piper capense. Vegetative reproduction by means of gemmae is a fairly frequent feature amongst some of the ferns, e.g. Tectaria gemmifera and Thelypteris madagascariensis, and especially amongst the epiphytic species of Asplenium, viz. A. sandersonii, A. gemmiferum and A. anisophyllum. Some vegetative spread may also occur through fragmentation of stems of Selaginella kraussiana and of certain succulent- and subsucculent-stemmed herbs, e.g. Crassula thorncroftii, Peperomia retusa, Impatiens duthieae, I. sylvicola, Pilea worsdellii and Clivia caulescens.

Apart from the construction of weirs and the digging of canals probably dating from the turn of the century, this site seems to have undergone little human interference. A mouldering large block of wood *may* be evidence of felling but no saw-pits were seen in the vicinity. The only other evidence of possible (selective) felling is negative, viz. the absence of large trees of *Cassipourea gerrardii*, as opposed to the abundance of smaller individuals of this species.

This stand, especially the upper levels, appears to be very stable. There will, however, presumably be a raising and evening up of the canopy, especially in the lower portion, together with possible increase of *Cryptocarya liebertiana*, *Syzygium gerrardii* and *Cassipourea gerrardii*, with the addition of *Cassine papillosa*, *Trichilia dregeana*, *Prunus africana* and *Xymalos monospora*. *Rawsonia lucida*, *Rinorea natalensis* and *Xymalos monospora* may be on the increase in the understory with the addition of *Diospyros whyteana* and *Teclea natalensis*.

The species composition of this riverine forest reveals affinities with postclimax and climax high forests of the Middle and Upper High Forest Zones respectively (cf. p.224-7 & p. 234-9). Some examples of the more significant common species are *Syzygium gerrardii*, *Cassine papillosa*, *Mackaya bella*, *Plectranthus swynnertonii*, *Isoglossa delicatula*, *Asplenium* spp., *Pilotrichella* spp., *Porothamnium comorense*, *Elaphoglossum acrostichoides*, *Trichomanes pyxidiferum* var. *melanotrichum* and *Cuscuta kilimanjari*.

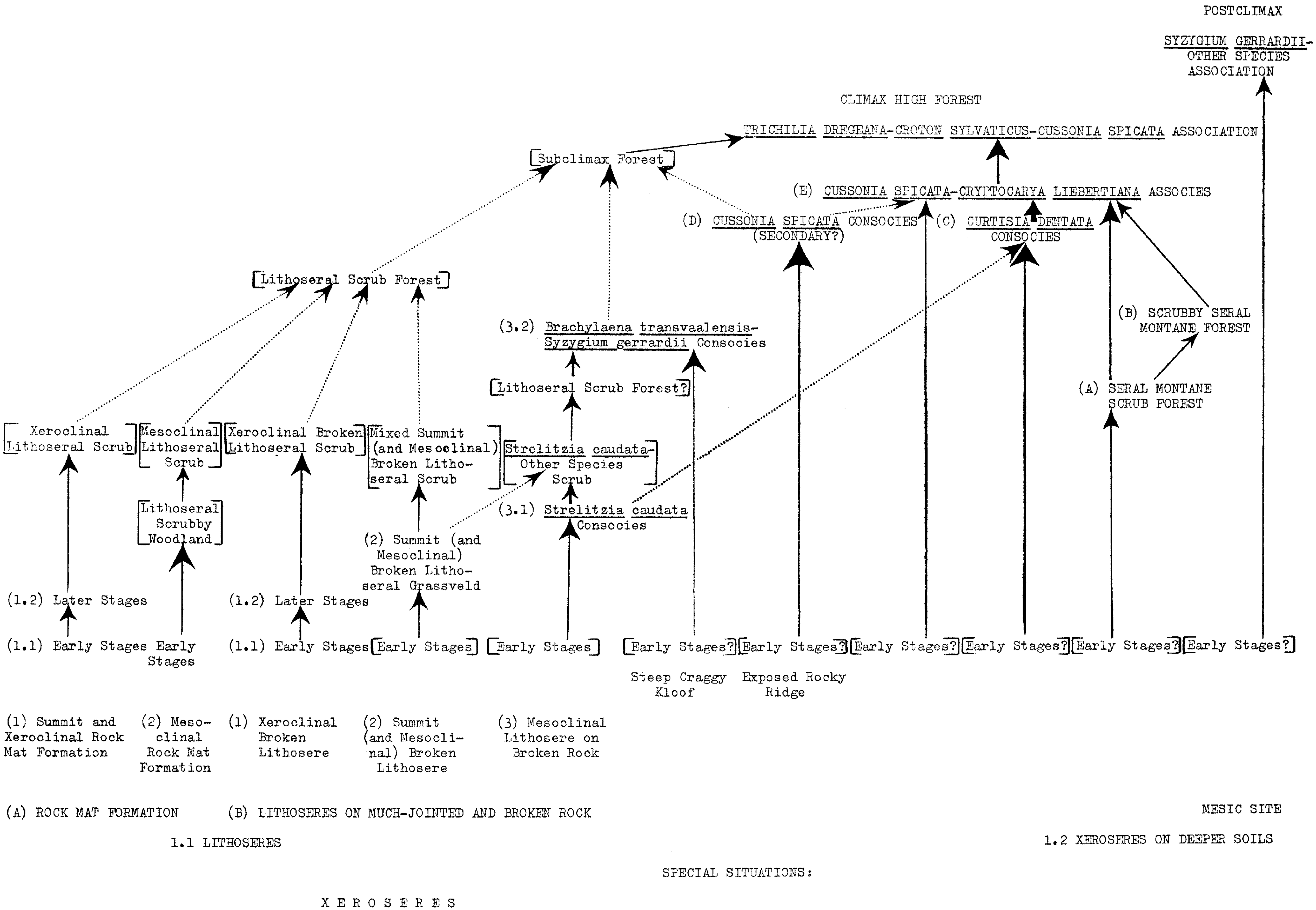

Fig. 9. Suggested successional trends and interrelationships of primary plant communities in the Middle High Forest Zone. Communities enclosed in square brackets are hypothetical.

B. THE MIDDLE HIGH FOREST ZONE

The Middle High Forest Zone lies well within the Mistbelt, mainly above 1275 m on the mesoclines but the lower limits are very much higher on the xeroclines. At its upper levels it grades into the Upper High Forest Zone, at about 1500 m on the average but the latter zone extends down to nearly 1400 m on the mesoclines. In this vicinity, the greater part of these two zones falls into the Grootbosch Government Forest Reserve but the Middle High Forest Zone is quite well represented on Westfalia Estate.

PLANT SUCCESSION

1. PRISERES

Suggested successional trends and interrelationships of natural and semi-natural plant communities of the Middle High Forest Zone are suggested in Fig. 9. No hydroseral stages have been observed except for a few marshy hollows which closely resemble those of the lower-lying zones in most respects.

THE XEROSERES

1.1 EARLY STAGES OF THE XEROSERES: THE LITHOSERES

The most extensive primary bare areas in this zone are found on the more or less level areas east of the actual summit knoll of Piesang Kop between about 1350 m and 1400 m. Far less extensive sheets of rock occur in the upper Madikeleni catchment on Fredericksdal. Both these primary areas consist of granite-gneiss bedrock.

The lithoseral stages represented can be regarded as belonging to the lithosere on broken rock or as leading to rock mat formation. These lithoseres can again be subdivided according to whether the general aspect is xeroclinal, summit or mesoclinal. The xeroclinal and mesoclinal lithoseres merge into the summit lithoseres in different places, i.e. on broken and on relatively unbroken bedrock respectively.

(A) ROCK MAT FORMATION

(1) Summit and Xeroclinal Rock Mat Formation. Earlier stages in the formation of rock mats may be seen on the more or less level and slightly mesoclinal sheets of granite-gneiss bedrock in the vicinity of

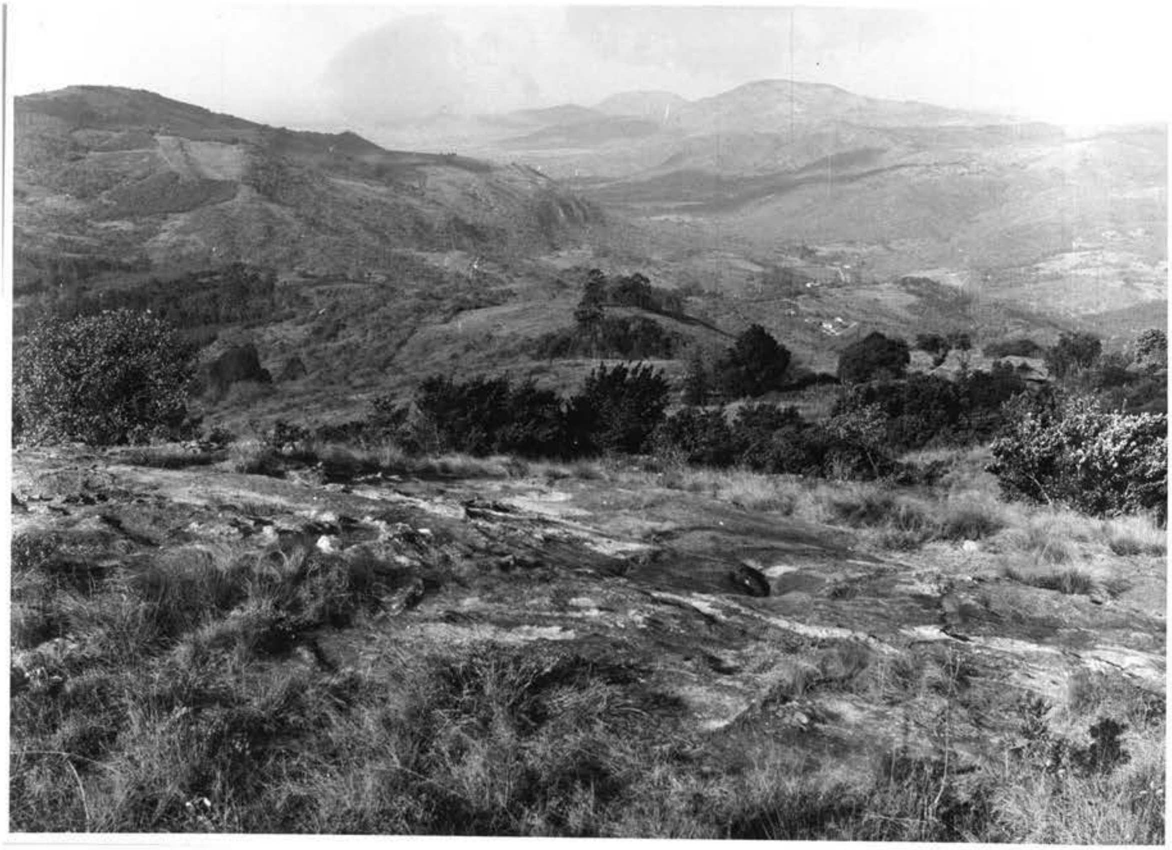

Plate 33. Rock mat formation on exposed sheet of granite-gneiss sloping slightly to north and northeast from beacon east of summit, Piesang Kop. Coleochloa setifera tufts in crevices and depressions.

the beacon east of the actual summit of Piesang Kop at about 1350 m elevation (see Plate 33). The site is fully exposed to the sun and winds which quite frequently bring mist and fairly heavy rainfall.

The granite-gneiss is here not much seamed or jointed although the outcrops are superficially much weathered and eroded giving rise in places to sunken pockets and larger shallow depressions containing water after rain. These microhabitats are particularly favoured by _Craterostigma wilmsii_, which may initiate the succession there. Elsewhere, the more usual course of succession is as follows:

(1.1) _Early Stages._ The bare rock surface is colonised by lichens. The more favourable sites, especially in small crannies and around the peripheries of the rock mats, are colonised by mosses and the following vascular plants, roughly in order of their respective appearance and importance:

Selaginella dregei	_Eragrostis capensis_
Pellaea viridis	_E. curvula_
Craterostigma wilmsii	_Coleochloa setifera_
Pellaea calomelanos (rather rare)	_Commelina_ sp., cf. _C. diffusa_
Sporobolus stapfianus	_Rhynchelytrum repens_
Crassula sp., aff. _C. nodulosa_	_Commelina africana_
C. muscosa (rather rare)	_Ficinia filiformis_
C. parvisepala (rare at first)	_Gerbera kraussii_
Senecio othonniformis	_Hypoxis angustifolia_
Aeolanthus rehmannii	_Cyperus albostriatus_
Cyanotis nodiflora	_Selago natalensis_
Loudetia simplex	_Conostomium natalense_ var.
Aristida transvaalensis	_Helichrysum lepidissimum_
Setaria flabellata	_Senecio erubescens_ forma
Thesium sp., cf. _T. costatum_	_Hemizygia rehmannii_
	Plectranthus arthropodus

Among the pioneer lithophytes and chasmophytes, several plants are found rooted in the crevices but spreading to trailing over the bare sheet of rock, thereby ameliorating conditions and providing niches for further colonisation of previously bare areas. These plants include _Rhynchosia monophylla_, _Tephrosia tzaneenensis_, _Argyrolobium adscendens_ and also, to some extent, _Pearsonia aristata_, _Adenia digitata_, _Vigna vexillata_, _Aeolanthus rehmannii_ and even _Rhynchosia angulosa_. In addition to the foregoing species, characteristic plants of the larger rock crevices and shallow soil pockets include _Panicum natalense_, _Digitaria monodactyla_, _Scilla natalensis_, _Tristachya hispida_, _Vellozia villosa_, _Aloe greatheadii_, _Trachyandra saltii_ var. _secunda_, _Gladiolus woodii_, _Acalypha punctata_, _Anthericum galpinii_, _A. transvaalense_ and _Raphionacme hirsuta_.

(1.2) _Later Stages._ As sufficient quantities of soil collect

Plate 34. Later stages of rock mat formation, near (roughly west of) beacon, on level area roughly east of actual summit knoll, Piesang Kop. Extensive invasion by the ericoid shrub Anthospermum ammanioides (against the skyline).

in the crevices and pockets, several plants enter the rock mats or increase in importance. These include Crassula parvisepala, Helichrysum lepidissimum and Hemizygia rehmannii, with occasional Anthospermum ammanioides, Becium knyanum, Indigofera sanguinea, Senecio erubescens forma and Vernonia natalensis.

The ericoid shrub Anthospermum ammanioides increases to become temporarily dominant (see Plate 34). Associated plants are the shrubby and subshrubby Cryptolepis oblongifolia, Plectranthus arthropodus, Vangueria infausta, Aeschynomene rehmannii var. leptobotrya and Helichrysum chrysargyrum, together with the forbs Callilepis salicifolia and Fadogia monticola, accompanied by Gladiolus sp., cf. G. crassifolius, occasional Alloteropsis semialata and other grasses, and scattered Clutia monticola and Pteridium aquilinum. Other woody and subwoody pioneers here are Canthium inerme and Diospyros lycioides subsp. sericea, with occasional Helichrysum odoratissimum, Lannea edulis and Vernonia corymbosa.

Myrica pilulifera makes an early appearance, especially on the more southerly to easterly aspects. Where the crevices and soil pockets are sufficiently numerous, it may contribute much towards the formation of a woodland dominated by M. pilulifera with Combretum kraussii subdominant, associated with Rhus rehmanniana, Brachylaena transvaalensis, Acacia ataxacantha, Cussonia spicata, Rhus transvaalensis and Faurea speciosa. Occasional Protea rhodantha trees are found on the steeper, rocky, (slightly) south-facing slopes amongst other characteristic woody lithophytes including Strelitzia caudata.

(2) Mesoclinal Rock Mat Formation. The only steeply inclined sheets of bare rock regarded as falling in the Middle High Forest Zone are the rock faces in the Madikeleni catchment in Fredericksdal, near the Belvedere boundary. These rock faces are situated in the vicinity of about 1350 m to 1375 m elevation, near the upper limit of the Middle High Forest Zone. The slope varies from steep to very steep and the aspect is generally easterly. The site is exposed to morning and midday sun and to mist and moisture-bearing winds, but sheltered from the late afternoon sun and westerly winds.

The mean annual precipitation is probably fairly heavy and the rate of evapotranspiration is likely to be comparatively low in view of the situation being cooler, damper and more sheltered than is usual. Nevertheless, effective precipitation is low because the smooth steep rock faces lead to high run-off and low infiltration per unit surface area. The scanty soil in small pockets consists of organic matter with usually rather gritty siliceous particles.

The general aspect is open with mats and cushions of herbaceous growth, accompanied by less frequent woody and subwoody plants in crevices, separated by bare rock. The more abundant lower early-stage ferns, forbs and grasses are Rhynchelytrum repens, Commelina spp. (localised), Kalanchoe rotundifolia, Pellaea viridis, Hyparrhenia hirta, Carex spicato-paniculata, Crassula rubicunda and Setaria sphacelata, with occasional Cymbopogon validus, Helichrysum polycladum, Melinis minutiflora and Panicum maximum. At later stages, Setaria chevalieri becomes locally common.

These herbaceous pioneers are accompanied and followed by low soft shrubs, undershrubs and tall subwoody forbs and ferns, viz. Crassula parvisepala, Helichrysum odoratissimum, H. setosum, H. umbraculigerum and Pteridium aquilinum. Pteridium aquilinum is rare at first but becomes locally common later.

Taller shrubby plants or small trees soon enter the sere, notably depauperate Vangueria infausta, together with Rhynchosia clivorum and occasional Clutia affinis, Diospyros lycioides subsp. sericea, Flemingia grahamiana and Lippia javanica, with suffrutescent Plectranthus arthropodus becoming increasingly abundant in places to locally dominant later. As trees enter the sere and grow in stature, Pouzolzia parasitica tends to become locally common under them.

Trees are at first irregularly spaced, becoming fairly regularly and closely spaced in places. The pioneer trees here are Combretum kraussii, Acacia ataxacantha, Brachylaena transvaalensis, Euclea crispa, Myrica pilulifera and Nuxia congesta.

The succession appears to be proceeding very slowly owing to extremely slow soil accumulation because of the steep slope's high run-off. The trend seems to be in the direction of a scrubby woodland.

(B) LITHOSERES ON MUCH-JOINTED AND BROKEN ROCK

(1) Xeroclinal Broken Lithosere. The quartziferous granite and granite-gneiss bedrock is much jointed and broken up to the north and east of the beacon east of the summit knoll of Piesang Kop, between about 1350 m and 1400 m. There is usually a slight to moderate slope, northwesterly to easterly in aspect. Fairly deep accumulations of gritty soil occur in the pockets between the rocks and boulders, which also provide protection from sun, wind and fire. Succession consequently proceeds very rapidly from the earliest stages and trees may become established at an early stage.

(1.1) Early Stages. The plants participating in the early stages of this sere are, roughly in order of their appearance, the following:

Coleochloa setifera
Mosses (various)
Selaginella dregei
Pellaea calomelanos
P. viridis
Loudetia simplex
Vellozia villosa
Senecio othonniformis
Aristida transvaalensis
Panicum natalense
Digitaria monodactyla
Eragrostis capensis
E. curvula
E. racemosa
Rhynchelytrum repens
Setaria flabellata
Thesium asterias
Trachypogon spicatus
Commelina africana
Hyparrhenia hirta
Pelargonium luridum (occasional)
Rhynchosia caribaea
Becium knyanum
Gerbera kraussii
Senecio erubescens forma
S. orbicularis (occasional)
Anthospermum ammanioides
Callilepis salicifolia
Cyperus semitrifidus
Hemizygia rehmannii
Cryptolepis oblongifolia
Pearsonia aristata
Tephrosia tzaneenensis
Rhynchosia angulosa
Selago natalensis
Fadogia monticola
Acalypha punctata
Scilla natalensis
Cyperus albostriatus
Plectranthus arthropodus
Cineraria fruticetorum
Helichrysum lepidissimum
Aeschynomene rehmannii var.
Helichrysum acutatum
Vernonia corymbosa
Aloe arborescens
Lippia javanica
Euryops pedunculatus
Combretum kraussii
Myrica pilulifera
Brachylaena transvaalensis
Acacia ataxacantha
Canthium huillense
Secamone alpinii

(1.2) Later Stages. Soil formation is likely to be very slow. Although this will probably retard succession, it seems reasonable to assume that the larger woody pioneers Acacia ataxacantha, Brachylaena transvaalensis, Canthium huillense, Combretum kraussii, Myrica pilulifera and others will increase and thicken up to form a scrub, if protected from fire, cutting and other disturbance. The formation of such a scrub will result in increased litter production. After lianes like Secamone alpinii have assisted towards the formation and closing of a canopy, a cooler damper microclimate will have been created, which will be more favourable for humification and so further succession.

(2) Summit (and Mesoclinal) Broken Lithoseral Sour Grassveld. The relatively advanced stage of the lithosere on much-seamed, jointed and broken rock described below occurs as a glade on the ridge east of the summit knoll of Piesang Kop at an altitude of about 1400 m. The aspect varies from almost level to sloping somewhat to the south. Misty weather is frequent and the precipitation is fairly heavy but the site is exposed to sun and wind.

The immature siliceous and humiferous soil is matted with roots and occurs in a shallow layer, if present, over slabs of granite-gneiss

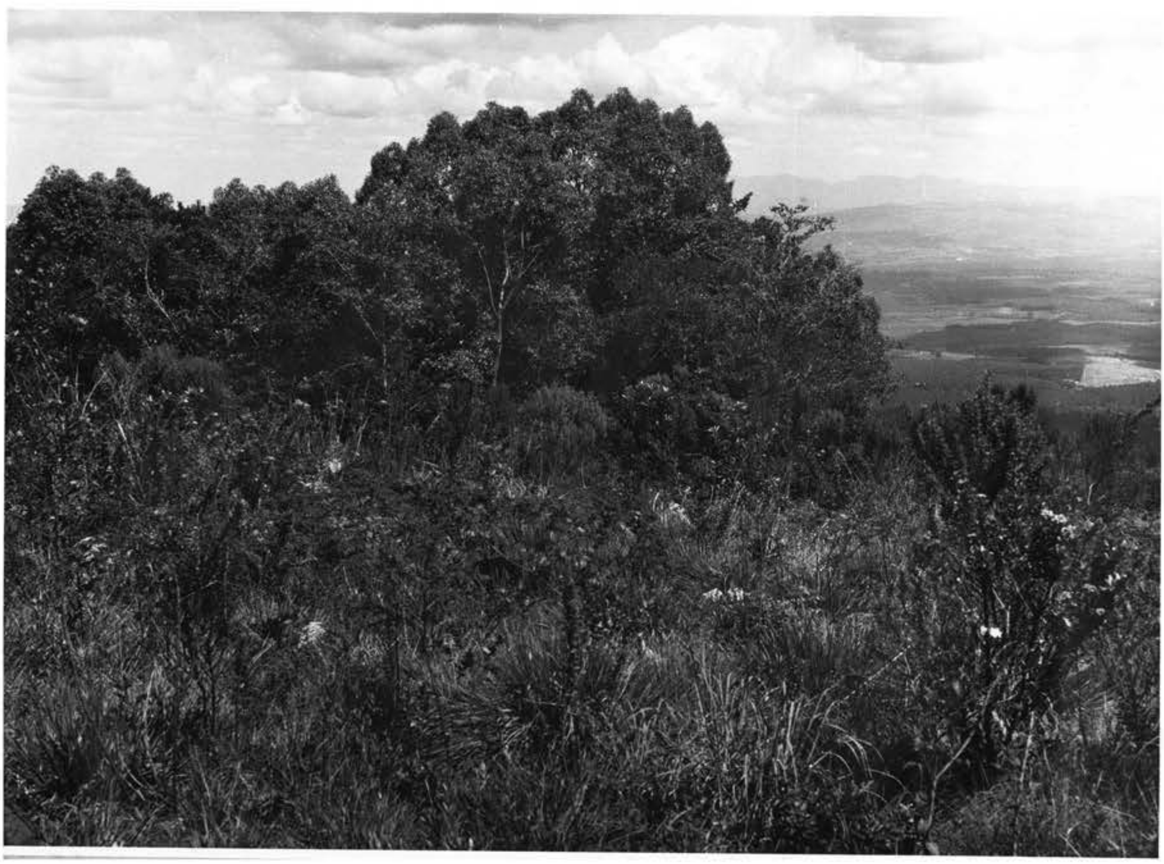

Plate 35. Scrubby Mesoclinal Summit Broken Lithoseral Sour Grassveld thickening up with Psoralea wilmsii, Pteridium aquilinum, Athanasia punctata, Anthospermum ammanioides, Rhynchosia clivorum and Vernonia spp., towards Canthium huillense fringe of scrub-forest margin of Catha edulis (gregarious), Rapanea melanophloeos and others.

bedrock and in deeper accumulations in pockets and crevices. Outcrops are common and conspicuous features in parts. Scattered localised early lithoseral stages are associated with these outcrops.

(2.1) Structure and Composition. This sour grassveld is tussocky and rank, and it gives every evidence of rapid invasion and thickening up with woody and subwoody plants, especially *Anthospermum ammanioides* and species of *Helichrysum* (see Plate 35).

(a) Grasses and Grass-like Plants. The general aspect is dominated by grasses and grass-like plants of which the following list includes the more important species:

Loudetia simplex
Setaria flabellata
Alloteropsis semialata (some moribund)
Harpechloa falx
Sporobolus centrifugus
Panicum natalense
Themeda triandra
Digitaria apiculata
Ficinia filiformis
Andropogon filifolius
Carex spicato-paniculata
Eragrostis curvula
Rhynchelytrum repens
Cymbopogon validus
Bulbostylis collina
Commelina africana
Helictotrichon turgidulum
Hypoxis angustifolia
Trachypogon spicatus

Coleochloa setifera, *Loudetia simplex*, *Panicum natalense*, *Cyanotis nodiflora*, *Trachypogon spicatus*, *Urginea pretoriensis* and *Vellozia villosa* are particularly characteristic of rock crevices.

(b) Forbs and Suffrutices. The tufted rosette-like monocotyledonous forbs and ferns are conveniently distinguished from the typical herbaceous and subwoody dicotyledonous forbs. The following are among the more abundant species of associated dicotyledonous forbs and suffrutices:

Gerbera kraussii
Hemizygia rehmannii
Rhynchosia monophylla
Vernonia sp., cf. *V. monocephala*
Selago natalensis
Knowltonia transvaalensis
Pelargonium luridum
Becium knyanum
Rhynchosia angulosa
Helichrysum lepidissimum
H. chrysargyrum
H. odoratissimum
Erica woodii (var.?)
Vernonia hirsuta
Nidorella auriculata
Pearsonia aristata
Argyrolobium adscendens
Pentanisia prunelloides
Plectranthus arthropodus
Senecio erubescens forma
Raphionacme hirsuta
Acalypha wilmsii
Clutia monticola
Helichrysum acutatum
Athrixia phylicoides
Clerodendron triphyllum
Plectranthus calycinus
Tephrosia macropoda
Helichrysum nudifolium var.
H. umbraculigerum
H. adscendens
H. polycladum
Indigofera sanguinea
Cineraria fruticetorum
Eriosema cordatum var.
Euryops pedunculatus
Aeschynomene rehmannii var.
Justicia anagalloides
Schistostephium crataegifolium

The above forbs are accompanied by occasional Crassula sp., cf. C. nodulosa, C. rubicunda and C. parvisepala, especially in rock crevices where they are associated with mosses, Selaginella dregei, Pellaea viridis, Psammotropha myriantha, the hemiparasitic Thesium asterias, Helichrysum wilmsii, Senecio othonniformis and S. sceleratus.

Several monocotyledonous forbs are scattered throughout the grassveld both in rock crevices and in deeper soil but they are nowhere frequent excepting the locally fairly frequent Watsonia transvaalensis. Others are Aloe boylei, Dierama medium, Aristea woodii, Eucomis undulata, Gladiolus sp., cf. G. crassifolius, Agapanthus inapertus, Gladiolus woodii and Hypoxis sp.

Ferns grow sporadically throughout, notably Pteridium aquilinum which is dominant over extensive areas and infrequent elsewhere. Less abundant but more widely spread is Pellaea viridis, while P. quadripinnata is comparatively rare.

(c) Shrubs. Associated and invading shrubby plants are evidently increasing, especially Anthospermum ammanioides together with Clutia affinis, Rhynchosia clivorum, Vernonia corymbosa, V. ampla and Psoralea wilmsii (see Plate 35).

(d) Lianoid Plants. The only conspicuous lianoid plant present is Smilax kraussiana.

(e) Trees. The more abundant invading small trees include Combretum kraussii, Rhus chirindensis forma legatii, Euclea crispa, Rhus transvaalensis, Acacia ataxacantha, Maesa lanceolata, Myrica pilulifera, Pittosporum viridiflorum, Protea rhodantha, Rapanea melanophloeos and Cryptocarya liebertiana occur on seamed bouldery granite-gneiss on the steep southern edge of the glade.

(2.2) Ecological Notes. The glade demonstrates interesting affinities with the large North-Eastern Mountain Sourveld glades between about the 1300 m and 1450 m levels on the Escarpment slopes on Rosendal-Fredericksdal (see p. 35-42 , Appendix A) and on the Escarpment summit at about 1600 m elevation in the Grootbosch Government Forest Reserve (see p. 231-3). Significant species shared with these glades include the following, the symbol ↑ signifying that the species concerned is shared with the latter glades in the Upper High Forest Zone (p.231-3):

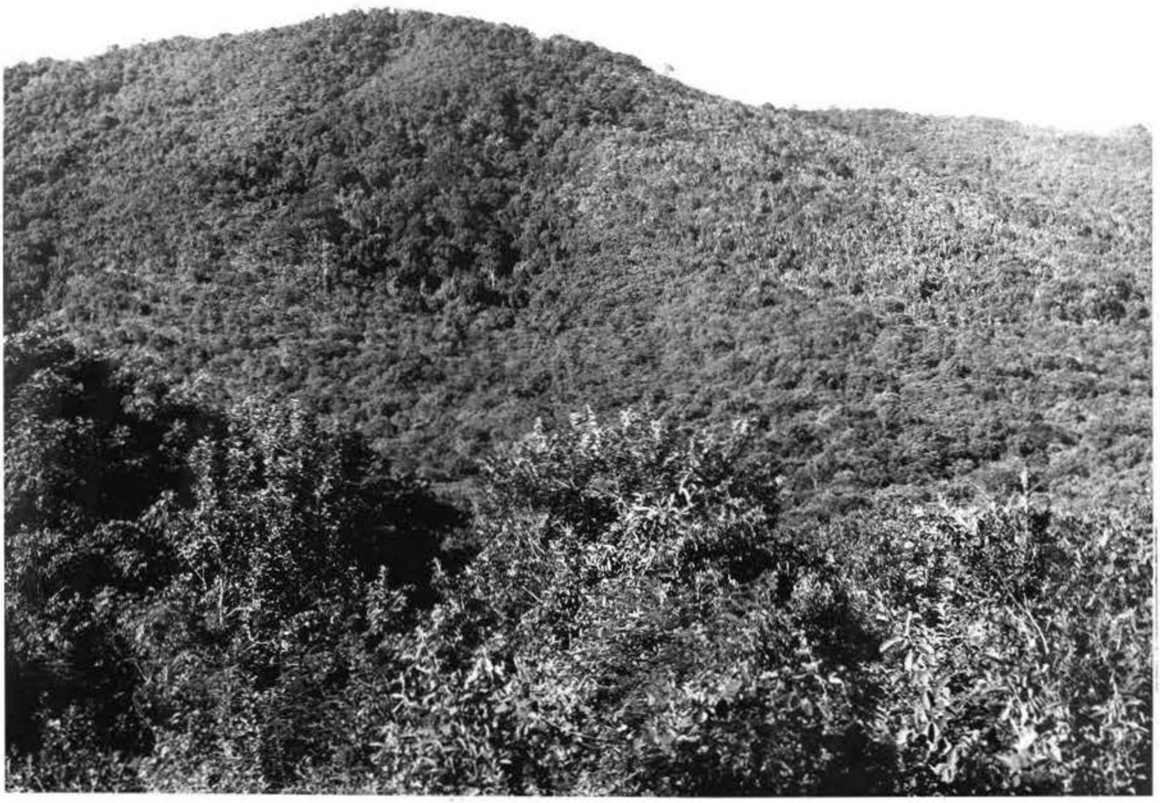

Plate 36. Upper southern slopes of central mass of Piesang Kop, showing extensive scrub vegetation characterised by Strelitzia caudata, to the upper right, with pale glaucous undersides of the leaves visible from a considerable distance.

Grasses and other Monocotyledons

Alloteropsis semialata ↑ *
Harpechloa falx ↑
Sporobolus centrifugus ↑
Themeda triandra
Digitaria apiculata
Andropogon filifolius
Aloe boylei ↑
Aristea woodii
Gladiolus sp., cf. *G. crassifolius*
Hypoxis sp. (↑)

Dicotyledonous Forbs

Acalypha wilmsii (↑)
Aeschynomene rehmannii var.
Helichrysum acutatum
H. lepidissimum *
H. odoratissimum
Plectranthus calycinus
Psoralea wilmsii ↑
Schistostephium crataegifolium

In addition, other distinctive plants of the Escarpment represented here are *Crassula* sp., aff. *C. nodulosa* (cf. N.R. Smuts 1093 from Haenertsburg) and *Watsonia transvaalensis*. Besides *Gladiolus* sp., cf. *G. crassifolius*, *Psoralea wilmsii* and *Watsonia transvaalensis*, other species apparently found nowhere else on Westfalia Estate except in this vicinity include *Helichrysum wilmsii*, *Helictotrichon turgidulum* and *Urginea pretoriensis* (in tufts of *Coleochloa setifera*). A small clump of *Schizachyrium jeffreysii* occurs amongst rocks in the boundary firebreak to the north of the glade, where aggregations of *Pachystigma venosum* also occur in shallow accumulations of gravelly sandy soil.

Leucosidea sericea links this vegetation with the *L. sericea*-dominated communities of the actual summit of Piesang Kop (see p. 51 *et seq.*, Appendix A) and with the more temperate vegetation of the main Escarpment. There seems to be no likelihood of a *Leucosidea sericea*-dominated community developing on this site, however.

A scrub community of very mixed species composition will probably arise consisting largely of the species listed on p. 195. The somewhat mesoclinal southern edge of the glade is likely to be characterised by the presence of *Strelitzia caudata* thus showing an affinity with the *S. caudata*-dominated lithoseral communities of the steeper mesoclines of Piesang Kop, discussed below.

(3) Mesoclinal Lithosere on Broken Rock.

(3.1) *Strelitzia caudata* Consocies. The heterogeneous vegetation complex discussed under this head is a conspicuous feature of the steep southern slopes of Piesang Kop, where communities with *Strelitzia caudata* dominant or codominant are well represented (see Plate 36). *Strelitzia caudata* is present in such quantity as to give a distinctive coloration and appearance to these slopes, hence the name "Piesang Kop" (in addition to *Ensete ventricosum*, *S. caudata* is popularly known as "Wilde Piesang" or "Wild Banana").

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* High-altitude form or ecotype.

These Strelitzia caudata-dominated communities have as their common feature the conspicuous part played by S. caudata but they differ widely in the relative abundance, size and species composition of the associated plants. A single stand has been selected for brief description as an example.

(a) Habitat. The stand described is situated on the steep upper northeastern slopes of the "hollow" formed by the upper headwaters of the western tributary of the Modyetsi Stream at an elevation of about 1300 m. The site is sheltered from winds except those from the south and, to some extent, from the southwest. The precipitation is substantial but the nature of the substratum renders the rainfall less effective.

The substratum consists mainly of a steep granite-gneiss face dissected by crevices and joints into typically large slabs, blocks and boulders. Boulders of diabase are also present. The soil is patchily distributed but may be deep in places suitable for soil accumulation.

(b) Structure and Composition. Because of the inhospitable substratum, this is an open community. Horizontally continuous strata are absent but several synusiae are present as set out below.

(i) "Canopy". The open to irregularly closed "canopy" consists largely of Strelitzia caudata. Associated trees include the following species:

Curtisia dentata	Cussonia umbellifera
Combretum kraussii	Dombeya burgessiae
Cussonia spicata	Heteromorpha trifoliata
Euclea crispa	Homalium dentatum
Apodytes dimidiata	Maytenus peduncularis
Brachylaena transvaalensis	M. heterophylla
Scolopia zeyheri	Myrica pilulifera
Allophylus transvaalensis	Trimeria grandifolia

(ii) Shrub Layer. The dominant shrub is dwarfed Myrsine africana, accompanied by Carissa bispinosa var. acuminata and occasional small Tricalysia capensis.

(iii) Field Layer. This stratum is probably mostly dominated by Setaria chevalieri where the canopy is more open and by Oplismenus hirtellus where it is closed, accompanied by Asparagus virgatus and Pellaea viridis.

(iv) Lianoid Plants. Some of the more abundant robust lianes and scramblers are Dalbergia armata, Rhoicissus revoilii, Cryptolepis capensis, Asparagus falcatus, Secamone alpinii and Smilax kraussiana. A characteristic small slender twiner is Ceropegia barbertonensis.

(c) Ecological Notes. The Strelitzia caudata-dominated communities represent earlier stages in the succession than the following closed-canopy communities into which they might develop on sufficiently favourable sites. On very steep slopes with poor soil accumulation, however, succession proceeds very slowly and is practically arrested at the Strelitzia caudata stage.

(3.2) Brachylaena transvaalensis - Syzygium gerrardii Associes. This lithoseral montane scrub forest is located on the steep south-facing bouldery slopes a short distance south to southwest of and below the summit knoll of Piesang Kop. Towards the east, it merges into a Strelitzia caudata - Other Species Associes.

(a) Habitat. This community lies between about 1300 m and 1350 m in altitude on the upper slopes of the catchment of the western tributary of the Modyetsi Stream in a "hollow" where mist is frequently apt to collect and slow to dissipate (cf. p. 178). The slope is steep and the aspect mainly southerly, varying from almost southeasterly to southwesterly, the mountainside being dissected by narrow ravines. The site is sheltered from most hot dry winds except those coming from a southerly to westerly direction. The rainfall is probably heavy and evapotranspiration normally low, but the precipitation per unit horizontal ground-sorface area is probably usually low because of the generally steep gradients. Interception by the canopy, stems, undergrowth, mosses, lichens and rock surfaces is high. Infiltration is, however, excellent.

The substratum consists largely of much-jointed granite-gneiss bedrock and scattered tumbled boulders of granite-gneiss and diabase with a very variable depth of litter, duff and humiferous soil. Erosion and run-off are probably negligible except over short distances and after exceptionally heavy storms. There is little evidence of disturbance.

(b) Structure and Composition. Strata are not clearly differentiated but the following synusiae are commonly present:

(i) Overstory. Scattered emergent trees of Syzygium gerrardii, up to about 15 m tall are found both in the ravines and, perhaps less often, on the ridges, together with occasional emergent Brachylaena transvaalensis, Cussonia spicata, C. umbellifera and Cryptocarya liebertiana, while tall _Celtis africana_ are more typically confined to the ravines.

(ii) _"Canopy"_. Most of the larger trees form an open to irregularly closed "canopy" from about 5 m up to about 12 m tall in places. The trees are mostly spaced along the joints and crevices of the rock except where the soil layer is sufficiently deep. The "canopy" is also variable in species composition. The dominant tree layer consists for the most part of small to medium-sized trees, especially _Brachylaena transvaalensis_, and more or less fully grown _Trimeria grandifolia_ associated with _Nuxia congesta_ and _Harpephyllum caffrum_ (particularly in the ravines). Other associated species are the following:

Cryptocarya liebertiana	_Rapanea melanophloeos_
Curtisia dentata	_Rhus chirindensis forma_
Cussonia spicata	_Scolopia zeyheri_
Dombeya burgessiae	_Syzygium gerrardii_
Euclea crispa	_Xymalos monospora_
Heteromorpha trifoliata	_Fagara davyi_
Homalium dentatum	_Croton sylvaticus_
Maesa lanceolata	_Halleria lucida_
Maytenus peduncularis	_Trichilia dregeana_
Mimusops zeyheri	_Celtis africana_
Pittosporum viridiflorum	_Cussonia umbellifera_

(iii) _Understory_ (about 2.5 m to 5 m in height). This stratum is fairly well represented in regard to species composition but potential canopy components are more abundant than typical understory trees. Of the latter trees, the more numerous species include _Trimeria grandifolia_, _Ochna o'connorii_, _O. holstii_, _Maytenus mossambicensis_ var. _mossambicensis_, _Tricalysia capensis_, _Bersama_ sp., cf. _B. transvaalensis_, _Dombeya burgessiae_, _Diospyros whyteana_, _Allophylus transvaalensis_, _Canthium inerme_, _Maesa lanceolata_, _Rhamnus prinoides_, _Cassipourea gerrardii_ and _Eugenia natalitia_.

(iv) _Shrub Layer_ (about 1 m to 2 m in height). This stratum is dominated by _Sclerochiton harveyanus_. Next in order are _Plectranthus fruticosus_, _Peddiea africana_, _Carissa bispinosa_ var. _acuminata_ and _Andrachne ovalis_, with _Mackaya bella_ in the ravines.

(v) _Field Layer_ (up to about 1 m in height):

Undershrubs and Taller Subwoody Herbs and Ferns. The Acanthaceous suffrutescent forb _Hypoestes verticillaris_ dominates this subclass. Associated with it is _Desmodium repandum_, accompanied by _Dryopteris inaequalis_, _Pteris catoptera_ (especially in ravines), Pteridium aquilinum, Stachys grandifolia, Cineraria fruticetorum, Adenocline mercurialis, Coleus rehmannii and Sparmannia ricinocarpa, with occasional Argyrolobium tomentosum, Helichrysum nudifolium var. quinquenerve, Indigofera schinzii, Justicia protracta and Senecio pandurifolius, with the tall climbing grass Prosphytochloa prehensilis.

Low Herbs and Ferns. The dominant low herb on deeper soils, and possibly dominating the field layer as a whole, is the grass Oplismenus hirtellus. It is accompanied by Carex spicato-paniculata, Galopina circaeoides, Chlorophytum comosum, Dietes vegeta and Pellaea viridis with occasional Lapeirousia grandiflora and Mohria caffrorum.

The saxicolous community is composed of the following more important species:

Streptocarpus parviflorus	Asplenium rutaefolium
Satyrium parviflorum	A. splendens
Stenoglottis fimbriata var.	Cheilanthes hirta
Peperomia retusa	Liparis neglecta
Polypodium polypodioides subsp.	Pleopeltis macrocarpa
Polystachya ottoniana	Kalanchoe rotundifolia
Asplenium aethiopicum	Mohria caffrorum (occasional)

(vi) Ground Layer. A ground layer consisting of crustose and foliose lichens, leafy liverworts and mosses is well developed on the rock surfaces where there is not too much litter. These plants undoubtedly derive much benefit from the mist, fog drip and dew.

(vii) Lianoid Plants. Climbers and scramblers are fairly numerous but mostly clamber up individual trees, contributing but little to the "canopy" and checking passage only slightly.

The more abundant lianoid plants reaching the canopy are Smilax kraussiana, Rhoicissus rhomboidea, R. revoilii, Asparagus falcatus, Entada spicata, Secamone gerrardii, Canthium gueinzii, Dalbergia armata, Rhoicissus tomentosa, Secamone alpinii, Jasminum streptopus var. transvaalense, Cephalanthus natalensis and Vernonia mespilifolia, with occasional Adenia gummifera and Mikania cordata.

The more common, smaller, soft, slender twiners present include Ctenomeria cordata, Behnia reticulata, Ipomoea wightii, Dumasia villosa, Riocreuxia torulosa, Senecio deltoideus and S. tamoides, with occasional Cissampelos torulosa, Cryptolepis capensis and Tylophora flanaganii.

(viii) Epiphytes. Several of the saxicolous herbs, especially the ferns listed above, are more typically epiphytic and in this community also occur as epiphytes, together with more obligate epiphytes. Besides the often very abundant epiphytic lichens and bryophytes, the more abundant epiphytes are Mystacidium caffrum, Polystachya ottoniana, Asplenium rutaefolium, Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii, Tridactyle tricuspis, Peperomia reflexa and P. retusa, with occasional Kalanchoe rotundifolia and Plectranthus fruticosus. Isolated small Cussonia spicata and Ficus craterostoma may also grow as epiphytes. The rich epiphytic flora, particularly of Neckeraceous mosses, indicates the frequent occurrence of mist.

(c) Ecological Notes. A characteristic feature of this stage of the mesoclinal lithosere is the specialised flora of the field layer growing with the ground layer on the rocky substratum. Apart from the more typically epiphytic plants, this saxicolous community appears to include relics of earlier stages, viz. Cheilanthes hirta, Kalanchoe rotundifolia, Mohria caffrorum and Satyrium parviflorum (cf. mesoclinal lithosere of Lower High Forest Zone, p.165-8, and of the Marginal Mistbelt, p.241-3).

This mesoclinal lithoseral scrub-forest community is apparently gradually changing into a subclimax type of cliff forest (cf. p.174-8) with a canopy and overstory probably eventually to consist largely of Cryptocarya liebertiana, Combretum kraussii, Cussonia spicata, Syzygium gerrardii, Pittosporum viridiflorum, Curtisia dentata, Nuxia congesta, N. floribunda, Trichilia dregeana, Cussonia umbellifera, Harpephyllum caffrum and Ficus craterostoma. Owing to the extreme rockiness and steepness of the site, soil accumulation is necessarily very slow and the succession is likely to remain arrested at a subclimax type of cliff forest with a specialised undergrowth, for the foreseeable future.

1.2 XEROSERE ON DEEPER SOIL

(A) SERAL MONTANE SCRUB FOREST

(1) Habitat. The following description is of a scrub-forest community situated on the southwestern slopes of Piesang Kop, immediately below the secondary *Euclea crispa* Consocies (see p.48-51 , Appendix A) into which it grades. The two communities have similar habitats. The stand is situated between about 1400 m and 1425 m on a moderately steep slope varying from about 15° to 20° from the horizontal, the aspect varying from southwest to west-southwest. The "canopy" is rather exposed to the afternoon sun and to westerly winds, which can be desiccating especially in early summer when atmospheric humidity is usually low. Under the canopy, however, it is usually shady, damp and cool.

There is no evidence of grazing or burning at least in the recent past.

(2) Structure and Composition. Strata are not well differentiated but some five synusiae can usually be distinguished as follows:

(a) Trees. Clearly differentiated overstory and understory strata are absent. Although the trees are fairly regularly spaced, the "canopy" varies from 5 m to nearly 15 m in height, the average height being probably between 8 m and 10 m. It is very mixed in composition but it seems typically to include the following species:

Brachylaena transvaalensis
Combretum kraussii
Eugenia natalitia
Halleria lucida
Maesa lanceolata
Trimeria grandifolia
Dombeya burgessiae
Heteromorpha trifoliata
Nuxia congesta
Syzygium gerrardii
Allophylus transvaalensis
Apodytes dimidiata
Cryptocarya liebertiana
Cussonia spicata
Fagara davyi
Pittosporum viridiflorum
Rapanea melanophloeos
Rhus chirindensis forma
Xymalos monospora
Calpurnia aurea

(b) Shrubs (1.5 m to 4.5 m tall). Shrubby plants are rather poorly represented. They seldom exceed 3 m in height although they may occasionally reach 4 m or more. Among the more abundant species are *Andrachne ovalis*, *Argyrolobium tomentosum*, *Peddiea africana*, *Sclerochiton harveyanus* and *Rhamnus prinoides*, with occasional *Carissa bispinosa* var. *acuminata*, fair-sized *Diospyros whyteana*, *Grewia occidentalis*, *Leonotis dysophylla*, *Maytenus mossambicensis* var. *mossambicensis* and isolated *Plectranthus fruticosus*.

(c) Field Layer (up to about 1 m, rarely to 1.5 m, tall).

(i) Low Soft Shrubs, Undershrubs and Taller Subwoody Forbs and Ferns. This poorly represented sublayer is dominated by *Desmodium repandum*, associated with *Adenocline mercurialis*, *Hypoestes verticillaris* (localised, lower portions), accompanied by *H. aristata* and *Sparmannia ricinocarpa*, with occasional *Cineraria fruticetorum*, *Euphorbia kraussiana* and *Justicia cheiranthifolia*.

(ii) Low Herbs and Ferns. *Oplismenus hirtellus* dominates this subclass and, indeed, the field layer as a whole. It is accompanied by *Cyperus albostriatus*, *Galopina circaeoides*, *Setaria chevalieri*, *Liparis neglecta* (localised), *Chlorophytum comosum*, *Dietes vegeta*, *Pellaea viridis*, *Achyranthes aspera*, *Asplenium aethiopicum*, *Dryopteris inaequalis*, *Lapeirousia grandiflora*, *Prosphytochloa prehensilis* and occasional *Haemanthus magnificus* among others.

(d) Lianoid Plants. Several species of lianoid plants are present, but few species are well represented.

(i) More Robust Lianoid Plants. The more abundant species of the larger, more woody lianes and scramblers are *Smilax kraussiana*, *Clematis brachiata*, *Rhoicissus rhomboidea*, *Secamone gerrardii*, *Asparagus falcatus*, *Jasminum streptopus* var. *transvaalense*, *Secamone alpinii*, *Canthium gueinzii*, *Cephalanthus natalensis* and occasional *Cryptolepis capensis*, *Mikania cordata*, *Pyrenacantha grandiflora*, *Rhoicissus tomentosa* and *Sphedamnocarpus galphimiifolius*, with isolated *Cnestis natalensis* and *Scutia myrtina*.

(ii) Less Robust Lianoid Plants. The more common softer slender twiners and scramblers include *Riocreuxia picta*, *Asparagus plumosus*, *Cissampelos torulosa* and *Rhynchosia caribaea* with occasional *Behnia reticulata*, *Cyathula cylindrica*, *Dioscorea retusa*, *Senecio deltoideus* and *Solanum bifurcum*, with isolated *Ipomoea wightii* and *Senecio tamoides*.

(e) Epiphytes. Apart from foliose and fruticose lichens (e.g. species of *Anaptychia*, *Parmelia*, *Ramalina* and *Usnea*) in the upper better-illuminated parts of the crowns and mosses lower down, epiphytes are rather infrequent. The only vascular epiphytes deserving of mention are *Pleopeltis macrocarpa* and *Polypodium polypodioides* subsp. *ecklonii* with occasional *Mystacidium caffrum* and very occasional *Asplenium rutaefolium*. Juvenile specimens of *Ficus craterostoma* are only infrequently encountered.

(3) Ecological Notes. To judge from the transgressives present, this community appears to be a stage in the development towards a subclimax type of forest consisting, inter alia, of the following species:

Canopy:

Syzygium gerrardii ↑	Fagara davyi
Cryptocarya liebertiana	Harpephyllum caffrum
Cussonia spicata	Nuxia congesta
Apodytes dimidiata	Rapanea melanophloeos
Brachylaena transvaalensis	Scolopia zeyheri
Combretum kraussii	Xymalos monospora
Curtisia dentata	Ficus craterostoma

Understory:

Eugenia natalitia	Ochna holstii
Trimeria grandifolia	Xymalos monospora
Allophylus transvaalensis	Canthium inerme
Bersama sp., cf. B. transvaalensis	Clausena anisata
Tricalysia capensis	Maytenus mossambicensis var.
Halleria lucida	Diospyros whyteana (occasional)

Shrub Layer:

Peddiea africana probably dominant or subdominant, with Sclerochiton harveyanus and Carissa bispinosa var. acuminata, together with smaller Clausena anisata and Maytenus mossambicensis var. mossambicensis.

Floor:

Oplismenus hirtellus probably dominant.

This suggested development may well take place by way of an intermediate scrubby forest stage similar in structure to that briefly described below, but this is not to say that the supposed scrubby forest stage will bear a strong resemblance to the latter scrubby forest in species composition.

The arrow after Syzygium gerrardii of the canopy trees indicates that S. gerrardii is found especially towards the tops of the ridges on the southerly slopes of Piesang Kop in the Middle High Forest Zone (cf. Killick, 1959: p. 61). Syzygium gerrardii occurring away from surface water is more typical of the Upper High Forest Zone. Its occurrence at this altitude may perhaps be ascribed to "Massenerhebung" effects exaggerating the depression of vegetation zones on the mesoclinal slopes of Piesang Kop, lying somewhat removed to seaward of the main Escarpment.

(B) SCRUBBY SERAL MONTANE FOREST

Between the Scrub Forest community just described and the Curtisia dentata Consocies on the ridge to the east (p.206-8), a scrubby forest with a presumably intermediate habitat is found.

(1) Structure and Composition. There is little evidence of stratification in this heterogeneous assemblage of species although the canopy is more or less closed, but the following synusiae are present:

(a) Canopy. A fairly complete canopy is formed but it is very variable and irregular in height. It consists of Cussonia spicata, Cryptocarya liebertiana, Homalium dentatum, Maytenus peduncularis, Mimusops zeyheri, Scolopia zeyheri, Syzygium gerrardii, Brachylaena transvaalensis and Combretum kraussii among others. Fully grown Ficus craterostoma and Maytenus mossambicensis var. mossambicensis also contribute to the canopy on occasion.

(b) Understory. The more conspicuous constituents of the discontinuous understory include Bersama sp., cf. B. transvaalensis (transgressive), Dombeya burgessiae, Maytenus mossambicensis var. mossambicensis, Ochna holstii, O. o'connorii and Tricalysia capensis.

(c) Shrub Layer. Typical shrubs of the undergrowth are Peddiea africana and Plectranthus fruticosus.

(d) Field Layer. This stratum consists largely of the undershrub Hypoestes verticillaris and the low grass Oplismenus hirtellus. Associated low herbs of the forest floor include Dietes vegeta, Liparis neglecta, Pellaea viridis and Asplenium splendens.

(e) Lianoid Plants. Included amongst the more abundant robust lianes and scramblers are Canthium gueinzii, Cephalanthus natalensis, Rhoicissus rhomboidea, R. tomentosa, Secamone gerrardii, S. alpinii and Smilax kraussiana.
Behnia reticulata is the most numerous slender twiner.

(f) Epiphytes. Besides the lichens and mosses, e.g. species of Usnea and Pilotrichella, a few vascular epiphytes are present - all species shared with the previously described Seral Montane Scrub Forest.

(2) Ecological Notes. This scrubby forest will probably evolve

into subclimax and climax forest without any intervening stage comparable to the Curtisia dentata Consocies discussed below.

(C) CURTISIA DENTATA CONSOCIES

(1) Habitat. The only stand of this community type on Westfalia Estate is found on a ridge to the south-southeast of the summit of Piesang Kop, east of the large "hollow", formed by the upper headwaters of the western tributary of the Modyetsi Stream, between about 1275 m and 1325 m altitude. The site slopes moderately to the south and is exposed to all except northerly winds. The crowns of the larger trees are exposed to full sunshine in midsummer but receive very much less in midwinter. The site tends to be frequently under mist and it is typically shady, damp and cool (to cold in winter). The resultant lowered rate of evapotranspiration combined with the high rainfall results in a favourable soil-moisture regime. Run-off is probably negligible except after heavy downpours.

The soil is a ferrallitic reddish brown clay with a mostly deep, friable, granular, humiferous topsoil and the surface litter and duff layers are mostly deep. The underlying rock is mainly granite-gneiss with scattered rocks of diabase.

Besides the areas churned up by bush pig, there is no sign of grazing or other disturbance by animals. Nor is there any evidence of tree-felling or any other disturbance by man except for the remains of some excavations, probably "vangkuile" ("pit traps" or elongated pitfalls) or perhaps graves.

(2) Structure and Composition. Three well-defined strata are present, viz. the canopy, the shrub layer and the field layer although the latter two are not always conspicuously distinct. Additional synusiae can also be distinguished.

(a) Canopy. The canopy is irregular in height, averaging between 10 m and 15 m, seldom less but sometimes as low as 8 m. It is more or less closed, consisting of a number of overlapping, obliquely spreading crowns of the dominant tree, pierced by occasional narrower crowns of the associated species. Large trees are widely but fairly uniformly spaced. Curtisia dentata dominates the canopy. It generally attains the greatest dimensions with widely spreading crowns. Associated trees include Apodytes dimidiata, Combretum kraussii, Cussonia umbellifera and Rapanea melanophloeos, with occasional Nuxia congesta, Scolopia zeyheri and Syzygium cordatum.

An understory is almost absent except for occasional full-grown Maytenus mossambicensis var. mossambicensis, Trimeria grandifolia and the few Vangueria infausta more than 2 m tall. Fair-sized but moribund specimens of Acacia ataxacantha may be infrequently encountered in the understory of the Curtisia dentata Consocies, perhaps providing a clue to the past conditions on this site. These "understory" species and Smilax kraussiana become progressively more abundant at higher levels as the C. dentata Consocies merges into a thorny almost impenetrably scrubby type of scrub forest. The latter grades into an open scrub of Euclea crispa and Hyparrhenia cymbaria to the west (see p. 48-51, Appendix A), or an open or closed scrub of Leucosidea sericea Consocies or L. sericea-Other Species Associes towards the summit (see p. 51-7, Appendix A).

(b) Shrub Layer (about 1 m to 2 m in height). Shrubs occur fairly frequently as individuals but this height class is poor in species of shrubs proper. The more abundant species are Peddiea africana, Myrsine africana and Vernonia umbratica, with occasional Carissa bispinosa var. acuminata.

(c) Field Layer (up to about 1 m in height).

(i) Low Shrubs, Undershrubs and Taller Subwoody Herbs and Ferns. This subclass is dominated by Hypoestes verticillaris with Desmodium repandum subdominant, accompanied by Justicia protracta (especially in the lower-lying portion), with occasional Asparagus virgatus, Isoglossa cooperi, Pteris catoptera and Sparmannia ricinocarpa.

The field layer also includes numerous small trees and shrubs. Particularly noticeable are stems and branches of Myrsine africana which frequently arise from lax stems trailing on and in the surface layers of litter on the ground.

(ii) Low Herbs and Ferns. Dominating this sublayer is the grass Oplismenus hirtellus, accompanied more especially by Galopina circaeoides, together with Pellaea viridis, Cyperus albostriatus and occasional Liparis sp.? (L. neglecta?).

(d) Lianoid Plants.

(i) Lianes and Scramblers. The more abundant robust lianoid plants include Secamone gerrardii, Rhoicissus rhomboidea, Secamone alpinii, Smilax kraussiana (scrubbier upper levels), Rhoicissus revoilii, Canthium gueinzii, Jasminum streptopus var. transvaalense, Cryptolepis capensis, Asparagus falcatus and Rhoicissus tomentosa, with occasional Choristylis rhamnoides, Cyphostemma anatomicum, Dalbergia armata and Sphedamnocarpus galphimiifolius.

(ii) Soft Slender Twiners. Among the more numerous less robust lianoid plants are Asparagus plumosus, Behnia reticulata, Ctenomeria cordata, Riocreuxia picta, Ceropegia barbertonensis, Cissampelos torulosa and Senecio tamoides, with occasional Dioscorea cotinifolia.

(e) Epiphytes. Apart from lichens (e.g. species of Ramalina and Usnea) and mosses, the only epiphytes noticed were occasional Mystacidium caffrum and Stenoglottis fimbriata var. saxicola.

(3) Ecological Notes. The attenuated shoots of Myrsine africana appear to arise mainly by vegetative spread. This proliferation seems to be a reaction to lowered light intensity which may foreshadow the eventual disappearance of this species from the community with complete closure of the canopy.

The Curtisia dentata Consocies appears to represent a transient stage in the succession to climax high forest. It seems likely that this community will be replaced by a mixed community with C. dentata assuming a subordinate rôle, except on the margins especially to the south and west. The canopy of the future associes will probably be composed largely of or, at least, include such trees as Combretum kraussii, Cussonia umbellifera, Rapanea melanophloeos, Scolopia zeyheri, Cussonia spicata, Fagara davyi, Cryptocarya liebertiana, Maytenus peduncularis, Pittosporum viridiflorum, Harpephyllum caffrum, Syzygium gerrardii, Celtis africana, Croton sylvaticus and Trichilia dregeana. Also likely to be present among the understory trees are Ochna holstii, Canthium inerme, Maytenus mossambicensis var. mossambicensis, Trimeria grandifolia, Allophylus transvaalensis, Diospyros whyteana, Clausena anisata, Maesa lanceolata, Rhamnus prinoides and Tricalysia capensis.

(D) CUSSONIA SPICATA CONSOCIES

(1) Habitat. The stand on which the following description is based is located to the south of and near to the summit portion of the Pisangkop-Christinasrust boundary firebreak, near to and somewhat east to southeast of the cairn on the top of the summit knoll of Piesang Kop. It lies on a moderate to steep mesoclinal slope at about 1400 m elevation.

The tree tops and open parts are exposed to hot sunshine in summer but are mostly shaded and cool to cold in winter. The site is somewhat exposed to winds especially from the south and east, which bring periodic heavy precipitation and mist. Owing to the broken up and locally rocky nature of the substratum with substantial surface layers of litter and duff, it would appear that good infiltration prevails with negligible run-off except locally after exceptionally heavy downpours.

The substratum consists mainly of locally shallow to deep friable humiferous to very humiferous ferrallitic red clay-loam drift soils over granite-gneiss bedrock dissected by diabase dykes. Besides loose rocks and boulders, outcrops of granite-gneiss and diabase occur in places.

(2) Structure and Composition. Stratification is scarcely discernible owing to the strata being obscured by the luxuriant growth of lianoid and shrubby plants under open parts of the discontinuous "canopy". The following synusiae are distinguished:

(a) Dominant Tree "Layer" or "Canopy". An overstory can be considered to be absent unless the tallest trees are regarded as emergents. The "canopy" is discontinuous and irregular in height where present. "Canopy" components average about 15 m in height, with often wide gaps between the tallest trees (up to about 20 m tall). This class is dominated by *Cussonia spicata*, associated with *Trichilia dregeana* and *Xymalos monospora* which also occurs as a "canopy" component but seldom exceeds 10 m in height. Other associated trees are *Cryptocarya liebertiana* and *Ficus craterostoma* together with occasional *Brachylaena transvaalensis*, *Combretum kraussii*, *Fagara davyi*, *Rhus chirindensis* forma *legatii* and *Syzygium gerrardii*.

(b) Understory. The understory, which is discontinuously developed under closed-canopy conditions, is here arbitrarily limited to trees between 2.5 m and 7.5 m tall. It consists mainly of medium-sized *Xymalos monospora*, *Rawsonia lucida*, *Allophylus transvaalensis*, *Cassipourea gerrardii*, *Dombeya burgessiae*, *Ochna holstii*, *Rothmannia capensis* and *Vangueria* sp. (*V. infausta*), together with occasional *Calpurnia aurea* (↑), *Diospyros whyteana*, exceptionally large *Maytenus mossambicensis* var. *mossambicensis*, *Rinorea angustifolia* and *Trimeria grandifolia*.

(c) Shrub Layer (about 1 m to 2 m in height). Beneath openings in the canopy, the undergrowth is choked by *Plectranthus fruticosus* (see Ecological Notes below). Under a closed canopy, this stratum is dominated by *Piper capense*, accompanied by *Peddiea africana* and *Andrachne ovalis*, with occasional *Carissa bispinosa* var. *acuminata*.

(d) Field Layer (up to about 1 m in height).

(i) Undershrubs, Taller Subwoody Herbs and Ferns. *Hypoestes verticillaris* clearly dominates not only this sublayer but also the field layer as a whole. It is accompanied by *Dryopteris inaequalis*, *Desmodium repandum* and *Pteris catoptera*, with occasional *Plectranthus laxiflorus* and *Pouzolzia parasitica*.

(ii) Low Herbs and Ferns. *Oplismenus hirtellus* and *Cyperus albostriatus* are present on the forest floor, together with occasional *Asplenium lobatum*, *Cardamine africana* and *Chlorophytum comosum*.

(e) Lianoid Plants. The undergrowth under canopy openings is practically impenetrable owing to the luxuriant growth of the scandent and subscandent plants as well as of *Plectranthus fruticosus* and other shrubs.

(i) Lianes and Scramblers. The more frequent robust lianoid plants present include the following species:

Rhoicissus rhomboidea
Canthium gueinzii
Mikania cordata
Mikaniopsis sp.
Rubus pinnatus
Cryptolepis capensis
Cyphostemma anatomicum
Cephalanthus natalensis
Smilax kraussiana
Asparagus falcatus
Clematis brachiata
Pyrenacantha grandiflora
Secamone alpinii
S. gerrardii
Jasminum streptopus var.
Rhoicissus tomentosa

(ii) Softer Slender Climbers. The more abundant species include *Tylophora flanaganii* (under closed canopy), *Solanum bifurcum*, *Behnia reticulata* (under closed canopy), *Senecio tamoides*, *Coccinia variifolia* and *Melothria cordata*, with occasional *Cissampelos torulosa*, *Dioscorea retusa*, *Ipomoea wightii*, *Riocreuxia torulosa* and *Senecio deltoideus*.

(f) Hemi-epiphytic Stranglers. *Ficus craterostoma* is found fairly frequently in all phases from completely epiphytic juvenile stages to large trees.

(g) Epiphytes. The most abundant epiphytes are innumerable mosses on the boles and lower branches of canopy trees, e.g. species of *Pilotrichella*. Lichens, such as species of *Ramalina* and *Usnea*, are present in the crowns. The most abundant vascular epiphytes are the ferns Asplenium rutaefolium and Polypodium polypodioides subsp. ecklonii accompanied by the phanerogamic Peperomia retusa. Besides numerous seedlings and small trees of the hemi-epiphytic Ficus craterostoma, small plants of the facultatively hemi-epiphytic Cussonia spicata are present.

(3) Ecological Notes. This community is predominantly evergreen. Striking instances of local aggregations of species are to be seen where the canopy is interrupted or absent over wide areas. In these places, Plectranthus fruticosus clearly predominates, accompanied by other shrubs such as Piper capense and occasional Maytenus mossambicensis var. mossambicensis. Also present are the suffrutescent Fleurya mitis (sometimes more or less lianoid), Hypoestes verticillaris, Isoglossa cooperi, Plectranthus laxiflorus and Pouzolzia parasitica, together with the ferns Dryopteris inaequalis and Pteris catoptera. This dense growth is made the more impenetrable by lianoid plants, viz. Rubus pinnatus, Senecio tamoides, Coccinia variifolia, Cyphostemma anatomicum, Mikania cordata, Rhoicissus rhomboidea, Solanum bifurcum and Tylophora sp.? (T. anomala?).

The successional status of this community is not clear. It may be a natural seral stage or possibly an arrested, deflected or retrogressed stage of succession. This latter possibility is suggested by the large discontinuities in the canopy, these openings being characteristically choked with shrubs and lianoid plants (cf. the Kloof Forest of the High Scrub Forest Zone, p.141-7; Cliff and Kloof Forests of the Lower and Middle High Forest Zones, p.174-8, 241-4 and 151; and Subseres of the Upper High Forest Zone, p.239), combined with the presence of fallen tree trunks in places. The tumbled tree trunks and the abundant loose rocks and boulders which, combined with and covered by the luxuriant growth of shrubs and lianoid plants, make the "open" strips almost impassable, suggest that these strips may possibly mark the site of a localised landslip or rockslide. The openings in the canopy appear to be in the form of strips as though felling had taken place along strips in cutting timber, or as though broad lanes were once cut for roads or surveying purposes. Inquiries along these lines have failed to elicit any historical information to account for the peculiar structure of this community and a minute examination of old and new aerial photographs has thrown no light on the problem. The possibility of large-scale toppling by wind seems to be remote.

This consocies resembles the Subclimax or Plagioclimax Cussonia spicata-Other Species Association of the Marginal Mistbelt (see p.244-50) in some respects e.g. dominance of Cussonia spicata and the importance of Calpurnia aurea up towards the northern boundary firebreak, but it seems doubtful that Marginal-Mistbelt conditions obtain on this site.

If not interfered with, it seems likely that this community will eventually develop into a closed-canopy high forest with a canopy composed, inter alia, of Cryptocarya liebertiana, Cussonia spicata, Trichilia dregeana, Brachylaena transvaalensis, Combretum kraussii, Fagara davyi, Ficus craterostoma, Scolopia zeyheri, Syzygium gerrardii, Cassine papillosa, Celtis africana, Rhus chirindensis forma legatii and occasional Xymalos monospora. The understory will probably consist largely of X. monospora, associated with Cassipourea gerrardii, Rawsonia lucida, Rothmannia capensis, Tricalysia capensis, Trimeria grandifolia, Allophylus transvaalensis, Halleria lucida, Ochna holstii, Diospyros whyteana, Eugenia natalitia, Oxyanthus gerrardii and Rinorea angustifolia.

(E) CUSSONIA SPICATA-CRYPTOCARYA LIEBERTIANA ASSOCIES

(1) Habitat. The rather dry type of high forest described here is found on two ridges running in a southerly to southwesterly direction from the shoulder on the western flank of Piesang Kop, between about 1300 m and 1350 m elevation. Observations were also made on the vegetation in an adjoining kloof.

The stand is mostly exposed to winds from all quarters except, to some extent, to those from a northeasterly direction. The site varies from gently sloping in the uppermost portion to moderately to steeply sloping below (i.e. 15° to 25° from the horizontal). The aspect varies mainly between southerly and south-southwesterly.

Precipitation is fairly heavy and mist occurs frequently. This community probably receives rather less rainfall than the Cussonia spicata Consocies just described and temperatures and evapotranspiration rates are generally probably rather higher owing to greater exposure to the sun, especially the afternoon sun, and to westerly winds.

Bedrock consists of diabase and granite-gneiss. The latter crops out especially on the steeper sides of the ridges while diabase outcrops trace the course of a dyke which runs the length of the eastern ridge. The soil is a humiferous granular ferrallitic clay loam for the most part but the outcrops usually carry a shallow humus soil. There is much litter and duff on the surface of the more level parts, sometimes with deep drifts of leaves. On steeper parts, however, there is little surface litter and duff owing to their being swept away during storms. Although there may be periods of high run-off during severe storms, infiltration is apparently usually fairly good and there is little evidence of erosion.

(2) Structure and Composition. In general aspect, this forest is

mostly closed to rather open in parts, especially towards the margins on ridges and down towards kloofs, which are steep, rocky and typically choked with lianes, shrubs and ferns. Stratification is evident on closer inspection, despite a rather scrubby appearance in places and the presence of numerous lianoid plants and transgressives. Some six or seven synusiae can usually be readily distinguished. True emergents appear to be absent. Exceptionally tall trees can still be considered part of the general canopy with which they remain connected by lianes and by way of the lower portions of their crowns.

(a) Canopy. The canopy is closed but uneven. The trees are irregular in height and spacing but well knit by lianes. The average height of the canopy seems to be about 20 m.

Cussonia spicata and Cryptocarya liebertiana are codominant with no real subdominants. Associated canopy components include Combretum kraussii, Croton sylvaticus, Curtisia dentata, Rhus chirindensis forma legatii, Trichilia dregeana, Brachylaena transvaalensis, Syzygium gerrardii, Scolopia zeyheri, Celtis africana, Nuxia floribunda and Prunus africana, with occasional Apodytes dimidiata, Ficus craterostoma, Nuxia congesta and Ocotea viridis. Fully grown Xymalos monospora may also occasionally contribute towards the canopy where it is low, rather open or irregular, but it is far more commonly found in the understory. Drypetes gerrardii, Fagara davyi, Harpephyllum caffrum, Homalium dentatum and Maytenus peduncularis may also occur sporadically in this stratum.

Scattered trees of Celtis africana, Cryptocarya liebertiana, Cussonia spicata, Homalium dentatum, Nuxia floribunda, Trichilia dregeana and Xymalos monospora grow with Ensete ventricosum and an abundance of smaller plants in the kloof a short distance to the east of the stand (cf. p.151 & Plate 22).

(b) Understory. The ages and sizes of understory components vary considerably with height ranging from 2.5 m to about 15 m. This stratum is dominated by small to fair-sized trees of Xymalos monospora with the small tree or large shrub Maytenus mossambicensis var. mossambicensis subdominant. The more numerous associated understory trees include the following species:

Trimeria grandifolia
Clausena anisata (especially margins)
Dombeya burgessiae (" " and kloof)
Tricalysia capensis
Rinorea angustifolia
Allophylus transvaalensis
Cassipourea gerrardii
Diospyros whyteana

Maesa lanceolata (especially margins)
Rothmannia capensis
Bersama sp.,cf. B. transvaalensis*
Eugenia natalitia
Grewia occidentalis (subscandent)
Ekebergia sp. ?(E. capensis?)
Maerua sp. ?(M. cafra?)
Oxyanthus gerrardii
Rawsonia lucida

(c) Shrub Layer (about 1 m to 2.5 m in height). This stratum is dominated by Sclerochiton harveyanus, often scrambling. The more abundant associated shrubs include Peddiea africana, Piper capense (especially towards the rivulet), Justicia campylostemon, Carissa bispinosa var. acuminata (mostly rather small), Plectranthus fruticosus and Mackaya bella.

(d) Field Layer (up to about 1 m in height).

(i) Low Soft Shrubs, Undershrubs and Taller Herbs and Ferns (mainly above 0.5 m tall). The most abundant species in this subclass is Hypoestes verticillaris, accompanied by the tall climbing grass Prosphytochloa prehensilis, as well as Pteris catoptera, Dryopteris inaequalis, Hypoestes aristata (near the margins), Desmodium repandum and Pouzolzia parasitica (especially in the vicinity of rock outcrops and towards the kloof).

The length of the watercourse in the kloof adjoining the forest is choked with vegetation dominated by the bracken-like fern Hypolepis sparsisora (cf. p. 143), accompanied by Fleurya mitis, Adenocline mercurialis, Ctenitis lanuginosa and the giant herb Ensete ventricosum in an open stand with scattered trees (see under Canopy above).

(ii) Low Herbs and Ferns (up to about 0.5 m tall). This sublayer, as well as the field layer as a whole is dominated by Oplismenus hirtellus, accompanied by Dietes vegeta. Liparis neglecta and Peperomia retusa are fairly frequent on rock outcrops. Others among the more frequent low herbs and ferns are Chlorophytum comosum, Cheilanthes bergiana, Pellaea viridis, Lapeirousia grandiflora, Asplenium lobatum, Haemanthus magnificus and Tectaria gemmifera (especially down towards the watercourse), with occasional Polystichum ammifolium.

Asplenium aethiopicum and A. splendens are found both on the soil

* Transgressive ? Up to about 15 m tall and almost reaching the canopy.

and on rocks. Asplenium inaequaelaterale also grows on the ground and in shallow humus soil on rocks close to the water in the watercourse. Besides growing epiphytically, A. gemmiferum and A. rutaefolium, Stenoglottis fimbriata var. saxicola and Streptocarpus parviflorus may also occur on rocks in hygrophilous forest and scrub forest near the watercourse. Where the watercourse community is more open, Crassula thorncroftii and Selaginella kraussiana are found on moist soil with liverworts (see Ground Layer below).

Ground Layer. Except for thallose and leafy Hepaticae on wet soil and stones by the sides of the rivulet, and very sporadically distributed moss colonies on the ground in drier parts, a ground layer is practically absent.

(e) Lianoid Plants.

(i) Lianes and Scramblers. The following list includes the more robust lianoid plants that reach the canopy:

Canthium gueinzii	Asparagus falcatus
Rhoicissus rhomboidea	Mikania cordata
R. tomentosa	Adenia gummifera
Secamone gerrardii	Entada spicata
Smilax kraussiana	Mikaniopsis sp.
Jasminum streptopus var.	Rubus pinnatus
Secamone alpinii	Vernonia mespilifolia
Pyrenacantha grandiflora	Dalbergia armata
Cnestis natalensis	Quisqualis parviflora (Lianoid Combretum kraussii)
Cyphostemma anatomicum	
Cephalanthus natalensis	Cryptolepis capensis
Clematis brachiata	Scutia myrtina (very infrequent)

(ii) Soft Slender Climbers. The less robust lianoid plants are generally more numerous than the robust lianes and scramblers although they do not produce the same mass of material in the ecosystem. The most abundant slender twiner is Behnia reticulata. Second in order of abundance is Tylophora flanaganii. Other slender climbers are Senecio tamoides (fairly frequent along watercourse), Solanum bifurcum, Asparagus plumosus, Cissampelos torulosa, Riocreuxia torulosa, Coccinia variifolia (especially margins and rock outcrops), Dumasia villosa (especially towards rivulet), Ipomoea wightii and Riocreuxia picta, with occasional Ctenomeria capensis, Oreosyce subsericea and Tylophora sp.? (T. anomala?).

(f) Hemi-epiphytic Stranglers. Ficus craterostoma has been mentioned as a canopy and understory component. Immature specimens of the hemi-epiphytic F. craterostoma are frequently present on the trees -

to such an extent that almost every large or fair-sized tree carries at least one specimen at some stage of its growth.

(g) Epiphytes. Numerous epiphytic lichens, e.g. species of Usnea and Ramalina, are found in the crowns of the taller trees, while bryophytes grow on the bark and dead wood at lower levels above ground. Vascular epiphytes present include Polypodium polypodioides subsp. ecklonii (conspicuous), Asplenium rutaefolium (occasionally also on rocks), Polystachya ottoniana, Peperomia reflexa, Pleopeltis macrocarpa, Tridactyle tricuspis and Mystacidium caffrum. Occasionally Trichomanes pyxidiferum var. melanotrichum and Asplenium gemmiferum are found growing epiphytically (as well as on rocks) in shady damp situations in riverine forest and scrub forest.

(3) Ecological Notes. The canopy constituents are for the most part evergreen. There are, however, some six deciduous and semideciduous species, viz. Croton sylvaticus, Homalium dentatum, Rhus chirindensis forma legatii, Celtis africana, Fagara davyi and Prunus africana (irregularly deciduous or semideciduous).

Although the trunks of the codominant and other canopy trees show some degree of buttressing, only Trichilia dregeana, Syzygium gerrardii, Scolopia zeyheri, Celtis africana, Calodendron capense, Drypetes gerrardii and Ficus craterostoma are markedly buttressed and fluted.

This appears to be a stabilised subclimax community, owing its stability to the marginal conditions imposed by the steepness and rockiness of the site. Nevertheless, the marked reproduction of Cryptocarya liebertiana and Trichilia dregeana, in particular, suggest a gradual succession tending towards a more mesophytic Cryptocarya liebertiana - Cussonia spicata - Trichilia dregeana Association or Associes comparable with the climax association (see p.217). In addition to Trichilia dregeana assuming codominance with Cryptocarya liebertiana, it may be supposed, to judge from its relatively poor reproduction, that Cussonia spicata will tend to become progressively less important in the course of time. It seems likely that there will be a simultaneous increase in the canopy of Scolopia zeyheri, Ficus craterostoma, Syzygium gerrardii, Fagara davyi, Homalium dentatum, Calodendron capense, Combretum kraussii and Ocotea viridis, with Xymalos monospora and, perhaps, Bersama sp., cf. B. transvaalensis, filling gaps in the canopy where it is low and discontinuous. With more complete closure of the canopy, trees more typical of earlier seral stages, exposed forest margins and rocky ridges, e.g. Brachylaena transvaalensis, Curtisia dentata, Nuxia congesta, N. floribunda and Rhus chirindensis forma legatii, will probably decrease in number as succession proceeds.

Understory trees more likely to increase are, more especially, Tricalysia capensis, Ochna holstii, Allophylus transvaalensis, Trimeria grandifolia, Bersama sp., cf. B. transvaalensis ? (suppressed transgressives?), Cassipourea gerrardii, Rothmannia capensis, Clausena anisata, Ochna o'connorii, Diospyros whyteana, Eugenia natalitia, Oxyanthus gerrardii and Rinorea angustifolia.

2. THE CLIMAX: TRICHILIA DREGEANA-CROTON SYLVATICUS-CUSSONIA SPICATA ASSOCIATION

The only stand of this high forest seen occurs on Enkeldedoorn in the vicinity of the upper forestry road from Christinasrust, some distance to the west of Spitskoppie, before it descends, near the Weltevreden boundary. The stand lies mainly above the road but the smaller portion below the road was also investigated.

2.1 HABITAT

This high forest community is found on the mesoclinal slopes of the Rakgwale Ridge between about the 1300 m and 1350 m levels. The ground slopes moderately above to fairly steeply below with an average gradient of about 20° from the horizontal. The aspect varies between south and southeast. The canopy is fully exposed to insolation in midsummer and progressively less so until midwinter when direct sunshine is appreciably reduced. Although temperatures at canopy level are undoubtedly fluctuating, cool conditions prevail. Under the canopy it is normally cool to distinctly chilly but frost-free. Evapotranspiration is probably relatively low most of the time except in the uppermost portion where it may be very high along the upper margin in hot weather if desiccating northerly to westerly winds are blowing.

The uppermost more level portion of the site, near the top of the ridge, approaches the Marginal Mistbelt transition zone (see Chapter VII, especially the Marginal Cussonia spicata - Other Species Association, p.244-50). Lower downslope, the forest is more sheltered from the northerly to westerly winds but fully exposed to southerly to easterly winds that are often moisture-bearing. Rainfall is probably fairly heavy. The mean annual precipitation probably exceeds 1500 mm. The pronounced dry season typical of the region may be aggravated for this site by its being situated close to the margin of this climatic region and, perhaps, by a partial rain shadow cast by Piesang Kop. Dry periods may be partially alleviated by misty weather, however.

Plate 37. Buttressed bole of emergent Prunus africana.

Granite-gneiss bedrock merges, especially upwards, into schistose xenoliths, sometimes locally amphibolitic in character. Diabase also crops out near the top of the ridge capping the steeper portions of the slope. The bedrock is overlain by a mantle of soil and variously weathered rocks and boulders of granite-gneisses, gneisses, schists and diabase that have moved downslope. The soils are immature but fairly granular, friable, humiferous ferrallitic clay loams of moderately to poorly structured red to brown drift-soil types. They are of variable depth but mainly shallow, over and between the rocks and boulders. There is typically a fairly deep layer of litter and duff. Infiltration appears to be good. Run-off and erosion are apparently absent except, perhaps, in the heaviest downpours.

This forest on Enkeldedoorn is reputed to be unexploited (W.M. Botha, p.c.; P.C. Smit, p.c.; cf. p. 5) and is, at present, relatively undisturbed except for the occasional removal of small timber and poaching by the local Bantu. The comparatively open nature of the undergrowth in places, especially towards the top of the ridge may be entirely owing to marginal environmental conditions, indicated by increased numbers of *Cussonia spicata* and *Ficus craterostoma* in the canopy correlated with greater exposure to sun and wind (cf. Marginal-Mistbelt *Cussonia spicata* - Other Species Association, p.244-50). On the other hand, the forests of the Rakgwale Ridge had, previous to White settlement, been encroached on from time immemorial by the local Bantu, who used to fell, burn and cultivate small patches inside the forest margin (W.M. Botha, p.c.; P.C. Smit, p.c.). It seems rather unlikely that the more level and easily accessible upper marginal portion of this forest would have escaped completely unscathed. Indeed, the increased numbers of *Cussonia spicata* and *Ficus craterostoma* in the uppermost portion suggest that a measure of selective removal of poles, wattles and sticks, if not big timber, may have taken place especially near the northern margin. Any such exploitation has, however, probably been light. Fires sweeping up the northern slopes of the ridge or started within the forest for clearing purposes or in attempts to collect honey may have done some damage in places from time to time. Nevertheless, this forest has the appearance of being in a good state of preservation. Even if it is not in a perfectly natural condition, it is the largest well-preserved patch of climax (or near-climax) high forest of this type on Westfalia Estate.

2.2 STRUCTURE AND COMPOSITION

This can be called a closed-canopy community but the canopy is somewhat uneven. Although the trees are fairly uniformly spaced on

Plate 38. "Profile" of forest edge at newly broadened and cleared roadside. In foreground: Cussonia spicata and Trichilia dregeana.

the whole, large trees are rather openly spaced with occasional openings in the canopy. The development of stratification varies widely but the following synusiae can generally be distinguished where the forest reaches its best development:

(A) OVERSTORY

The only tree that could be comfortably classed as an emergent is a specimen of Prunus africana about 30 m tall and between 1 m and 2 m dbh (rather heavily buttressed and fluted, see Plate 37).

(B) CANOPY

The canopy is mostly closed but rather irregular in height, although probably averaging about 20 m. It is very mixed in composition but it seems justifiable to name the community after the first three of the more abundant canopy components listed as follows:

Trichilia dregeana (see Plate 38)	Kiggelaria africana
Croton sylvaticus	Xymalos monospora
Cussonia spicata (↑) (see Plate 38)	Celtis africana
Cryptocarya liebertiana	Scolopia zeyheri
Ficus craterostoma (↑)	Calodendron capense
Nuxia floribunda	Combretum kraussii
Brachylaena transvaalensis	Prunus africana
	Ocotea viridis (rare)

Surprisingly, Syzygium gerrardii appears to be absent or very rare in the canopy. Trema orientalis has been seen as a canopy component where the canopy has, apparently, formerly been opened up. It is more characteristic of the forest edge and forest near the upper edge where it occurs with Cussonia spicata, Fagara davyi, Ficus capensis, F. craterostoma, Homalium dentatum, Celtis africana, Curtisia dentata, Rapanea melanophloeos, Rhus chirindensis forma legatii and Apodytes dimidiata (cf. Marginal Cussonia spicata - Other Species Association, p.244-50).

Although Xymalos monospora and also Rothmannia capensis (up to 20 m tall), Cassipourea gerrardii (to 15 m tall and more), Halleria lucida (to 8 or 9 m tall), Maesa lanceolata, Bersama sp., cf. B. transvaalensis, Cassine papillosa, Ochna holstii and O. o'connorii contribute to the canopy where it is low or where there are gaps,it is perhaps better to consider them understory constituents. Although Bersama sp., cf. B. transvaalensis can grow to a great height (specimens from about 20 m to 25 m have been seen), this species is more commonly found as a transgressive in the lower stories.

(C) UNDERSTORY

This stratum of small trees, from about 3 m to 15 m tall, is locally poorly developed, as far as obligate understory trees are concerned, being dominated over extensive areas by potentially taller trees especially Xymalos monospora. The more abundant typical understory components include the following species:

Cassipourea gerrardii
Rinorea angustifolia
Clausena anisata (↑)
Maytenus mossambicensis var. (↑)
Psychotria capensis
Oxyanthus gerrardii
Trimeria grandifolia (↑)
Eugenia natalitia
Maesa lanceolata
Rawsonia lucida
Rothmannia capensis

Allophylus transvaalensis (↑)
Bersama sp., cf. B. transvaalensis
Tricalysia capensis
Pavetta lanceolata (↑, near margin)
Teclea natalensis
Canthium inerme (↑)
Cassine papillosa (↑, especially [transgressive)
Diospyros whyteana
Halleria lucida (↑)
Ochna holstii
O. o'connorii

(D) SHRUB LAYER

This stratum, about 1.5 m to 2.5 m in height, is poor in the number of species of shrubs proper, although Piper capense completely dominates the undergrowth and, probably, the whole community in numerical abundance. The subdominant shrub is Mackaya bella, especially in the upper portion of the forest. Plectranthus fruticosus also occurs here and there, particularly where the canopy is interrupted. Justicia campylostemon is only infrequently scattered. Peddiea africana is also of rather rare occurrence as is Carissa bispinosa var. acuminata, except towards the forest margins.

(E) FIELD LAYER

The field stratum, up to about 1.5 m in height, is rather poorly developed on the whole, much of the area being covered by thickets of Piper capense interspersed with an appreciable total area of bare ground, owing to the dense shade cast by this shrub. The field layer is conveniently considered to consist of two sublayers as follows:

(1) Undershrubs, Taller Subwoody Herbs and Ferns. Hypoestes verticillaris is clearly dominant in this subclass with Pteris catoptera next in order but very much less numerous. These plants are accompanied by Tectaria gemmifera, Adenocline mercurialis, Desmodium repandum, Dryopteris inaequalis and perhaps, at times, Isoglossa delicatula (small

plants which may be of this species were seen but did not fall into this sublayer in 1962: cf. p. 187). Thalictrum rhynchocarpum occurs in damp places e.g. in seepage areas. The Acanthaceous undershrubs Dicliptera clinopodia, Phaulopsis imbricata and Hypoestes aristata may grow where the canopy has been opened.

(2) Low Herbs and Ferns. Although only locally abundant, Oplismenus hirtellus is dominant in this sublayer. Associated herbs and ferns of the forest floor are Dietes vegeta with Sanicula elata (especially in disturbed places), accompanied by Impatiens duthieae, I. sylvicola, Polystichum ammifolium, Asplenium lobatum and A. splendens, with isolated Haemanthus magnificus. Crocosmia aurea may be locally fairly frequent near the forest margins, especially in moist places like seepages in small kloofs. Asplenium gemmiferum also grows on rocks in such wet places.

Another microhabitat worthy of mention is provided by outcrops of rock and scattered boulders covered with a shallow layer of litter and leaf-mould. For instance, an outcrop of diabase in the upper portion has been seen to carry a distinctive flora including Peperomia retusa, Disperis lindleyana, Begonia sonderiana, the filmy fern Trichomanes pyxidiferum var. melanotrichum and several mosses. Besides growing epiphytically, Streptocarpus parviflorus is found on rocks and, sometimes, on soil.

(F) GROUND LAYER

The ground layer is limited in extent, consisting of mosses and Jungermanniales confined mainly to litter-free rock surfaces, e.g. Porothamnium comorense.

(G) LIANOID PLANTS

(1) Lianes and Scramblers. The following list includes the more abundant robust woody lianoid plants:

Cyphostemma anatomicum	Secamone alpinii
Rhoicissus tomentosa	Pyrenacantha grandiflora
R. rhomboidea	Cephalanthus natalensis
Mikania cordata	Cryptolepis capensis
Asparagus falcatus	Vernonia mespilifolia
Canthium gueinzii	Adenia gummifera
	Clematis brachiata

Rhoicissus revoilii may also occur sporadically. Choristylis rhamnoides and Cnestis natalensis also occur, more especially towards the forest margin and where the canopy is more open, where Grewia occidentalis, too, may occur as a large scrambling scrub.

(2) Softer Slender Climbers. Although smaller and, perhaps, less conspicuous than the lianes and scramblers, the less robust lianoid plants are usually more abundant. By far the most abundant species are Behnia reticulata and Tylophora flanaganii. They are accompanied by fewer Solanum bifurcum, Jasminum streptopus var. transvaalense, Senecio tamoides, Coccinia variifolia and others including occasional Dioscorea retusa.

Although Jasminum streptopus var. transvaalense, Senecio tamoides and Coccinia variifolia do occur under a closed canopy, they are more commonly found with subscandent Fleurya mitis, Ipomoea wightii and Smilax kraussiana, together with occasional Ctenomeria capensis, Dumasia villosa, Riocreuxia picta ?(R. torulosa?), Senecio deltoideus and Stephania abyssinica towards the forest margin where the canopy is more open.

(H) HEMI-EPIPHYTIC STRANGLERS

The strangler Ficus craterostoma, which starts life as an epiphyte, is of frequent occurrence, practically every fair-sized tree supporting seedlings and young trees of various sizes.

(I) EPIPHYTES

Quantities of epiphytic lichens, leafy liverworts (notably Jungermanniales) and mosses, e.g. species of Neckera and Pilotrichella cover the bark of the larger rough-barked trees in particular. Vascular epiphytes also favour the larger rough-barked trees, e.g. Cussonia spicata and Prunus africana. The most numerous of the abundant vascular epiphytes are the ferns Polypodium polypodioides subsp. ecklonii (↓) and Asplenium rutaefolium (↑), accompanied by Pleopeltis macrocarpa and the orchid Polystachya ottoniana with the dicotyledonous Peperomia reflexa (↓), P. retusa and Streptocarpus parviflorus. Other epiphytic ferns are Trichomanes pyxidiferum var. melanotrichum, Asplenium anisophyllum and A. gemmiferum, mostly confined to moist places, e.g. small kloofs. Asplenium splendens sometimes occurs as an epiphyte as do also seedlings of one of the codominant trees, viz. Cussonia spicata.

(J) PARASITIC PLANTS

The only physiologically dependent plant noted was the epiphytic twiner Cuscuta kilimanjari, parasitic on the softer shrubby plants, e.g. Plectranthus fruticosus, near the forest margins and where the canopy is more open.

2.3 ECOLOGICAL NOTES

The canopy trees are, for the most part, evergreen. Only Croton sylvaticus and Celtis africana are truly deciduous although several other species are irregularly deciduous or semideciduous.

Buttressing and fluting is not very marked except on old trees but does occur to some extent, with Prunus africana, Cussonia spicata, Trichilia dregeana, and more markedly, with large old specimens of Calodendron capense, Celtis africana, Kiggelaria africana, Nuxia floribunda, Scolopia zeyheri, Homalium dentatum, Cryptocarya liebertiana (irregularly fluted) and Ficus craterostoma.

The stand as a whole gives the impression of stability. To judge by the proportions of transgressive trees observed, it seems that such changes as will take place will largely be minor readjustments in the relative abundance of component species. As far as canopy trees are concerned, it appears that Cryptocarya liebertiana, Trichilia dregeana, Cussonia spicata, Ficus craterostoma, Ocotea viridis, Cassine papillosa, Celtis africana, Homalium dentatum, Kiggelaria africana, Scolopia zeyheri and, perhaps, Xymalos monospora will tend to increase at the expense of Croton sylvaticus, Nuxia floribunda, Brachylaena transvaalensis, Calodendron capense, Combretum kraussii and Trema orientalis. It must be remembered, however, that the observations on which these impressions are based represent a very inadequate sample of the stand, and that these impressions cannot, therefore be regarded as authoritative.

3. POSTCLIMAX:

SYZYGIUM GERRARDII-OTHER SPECIES ASSOCIATION

3.1 HABITAT

This mesic forest community is to be found just south of the northern watershed of the Madikeleni Catchment below the old waggon track on Rosendal, near the upper portion of the Fredericksdal boundary. The stand investigated is situated towards the northern edge of a large shallow "hollow" on the mountainside at levels a little below the 1330 m level. The ground slopes steeply to very steeply. On the lower, very steep gradients the forest merges into scrub forest. The aspect varies mainly between easterly and east-southeasterly.

The forest is thus fully exposed to the mist- and moisture-bearing winds from the east and south as well as being sheltered from the west and, to some extent, from the north. The rainfall is presumably heavy and the site is cool and damp, as a rule. Although patchily sunny in the morning, the site is shaded in the afternoon by the crowns of the trees and the Escarpment to the west. The high forest is found in broad shallow but very steep kloofs, formed by the back-cutting headwaters of the Madikeleni Stream. The ground is very uneven. It is conceivable that these kloofs may mark the sites of ancient slumping or landslips which have since become stabilised.

The soil and subsoil are mostly deeply weathered drift soils mainly over granite-gneiss but diabase may be present. The soils are typically of a fairly mature fêrrallitic clay-loam type, leached but humiferous, with much litter. The humus content may be quite high locally, probably owing to the prevailing cool conditions.

Run-off coupled with erosion is probably low to negligible but surface wash and erosion could be very severe during and after heavy downpours owing to the steep slopes and added run-off from the glade upslope. There seems to be ample underground moisture relatively near the surface, derived by percolation from upslope, as attested to by the abundance of Prosphytochloa prehensilis in the field layer and the presence of liverworts on the ground in places.

There is no evidence of tree-felling or other human disturbance. No traces were seen of fire. The forest appears to be in a natural condition.

Because of the steep and uneven terrain and the sometimes impenetrable tangled masses of the hispid scrambling grass Prosphytochloa prehensilis, this community is very difficult to sample adequately. The following description should be read bearing this in mind.

3.2 STRUCTURE AND COMPOSITION

Although large trees do stand with their crowns largely clear of the surrounding crowns, no truly emergent trees seem to be present and the larger trees are rather to be considered as contributing to the formation of an irregular uneven canopy. The canopy is more or less closed by the widely spreading crowns of the constituent trees which are widely but fairly regularly spaced. There is much open space below the canopy. Stratification is poorly developed for the most part although such strata as are present are well differentiated even if they are not all equally well represented. In the community as a whole, some seven or eight synusiae can be distinguished as set out below:

(A) CANOPY

The canopy presents an uneven upper surface of rounded umbrageous crowns averaging about 20 m in height above ground. It is composed of several species of well-spaced, well-grown fine specimens of trees, notably *Syzygium gerrardii*, *Combretum kraussii*, *Cussonia spicata*, *C. umbellifera*, *Rapanea melanophloeos* and *Xymalos monospora*.

(B) UNDERSTORY

The understory is very discontinuous and variable in height ranging from about 3 m to about 10 m tall (*Xymalos monospora*). Understory components include *Canthium inerme*, *Dombeya burgessiae*, *Ochna holstii*, *Tricalysia capensis* and *Xymalos monospora*, with occasional *Eugenia natalitia* large *Maytenus mossambicensis* var. *mossambicensis*, *M. peduncularis*, *Ochna o'connorii* and *Rawsonia lucida*. Apart from *Xymalos monospora*, potential canopy trees are only very infrequently encountered in the understory and merit no further mention.

(C) SHRUB LAYER

The shrub stratum (about 2 m to 3 m in height) is very poorly developed and composed mainly of transgressives and a few fair-sized *Plectranthus fruticosus*. Transgressive trees are also sparse and these consist mostly of *Dombeya burgessiae*, with occasional *Maytenus mossambicensis* var. *mossambicensis*, *Ochna holstii*, *O. o'connorii*, *Rawsonia lucida* and *Tricalysia capensis* amongst others.

(D) FIELD LAYER

This stratum (up to about 2 m in height) is dominated by large sprawling and scrambling masses of the hygrophilous grass Prosphytochloa prehensilis, accompanied by the undershrub Phaulopsis imbricata, the ferns Dryopteris inaequalis, Pellaea viridis and Pteris catoptera with occasional Dietes vegeta.

(E) GROUND LAYER

A ground layer is only very sporadically developed where the ground is free of higher plants and litter, as on exposed roots and rocks and where soil banks are so steep as to cause litter to slip off under gravity. Liverworts may be present as well as mosses, indicating the favourable moisture regime in the substratum and the prevailing humid conditions below the canopy.

(G) LIANOID PLANTS

With the exception of Prosphytochloa prehensilis in the field layer, climbing plants are poorly represented and lianes and scramblers very seldom contribute to or even reach the canopy. The distinction between the larger and woodier and the slender softer climbers is more difficult to uphold than usual, especially with Jasminum streptopus var. transvaalense and Smilax kraussiana. Nevertheless, it is considered more realistic to recognise the differences than to ignore them.

(1) Lianes and Scramblers. The most abundant species amongst the more robust lianoid plants appears to be Secamone gerrardii, accompanied by occasional Canthium gueinzii, Cnestis natalensis, Cryptolepis capensis, Entada spicata and Jasminum streptopus var. transvaalense.

(2) Softer Slender Climbers. The most abundant slender twiner seems to be Ipomoea wightii. It is accompanied by occasional Behnia reticulata and Smilax kraussiana.

(H) EPIPHYTES

On an admittedly cursory inspection, hemi-epiphytic stranglers do not appear to be represented. They are certainly not conspicuous.

Lichens, notably species of Usnea and Ramalina, may be conspicuous in the crowns of the larger trees exposed to sunshine and wind-borne mist. Epiphytic mosses occur lower down where more shady and humid conditions prevail and where there is more stem-flow. Vascular epiphytes such as Asplenium rutaefolium, Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana may occur here and there. They are neither abundant nor conspicuous on the branches of smooth-barked trees such as Cussonia umbellifera and Syzygium gerrardii although the localised orchid Tridactyle tricuspis seems to favour the crowns of the latter species.

3.3 ECOLOGICAL NOTES

The canopy components are predominantly evergreen.

Buttressing may be fairly well developed amongst canopy trees, especially Syzygium gerrardii, Cussonia spicata and C. umbellifera and also, to some extent, Combretum kraussii.

The abundance of such mesophytic and hygrophilous species as Syzygium gerrardii, Cussonia umbellifera and Prosphytochloa prehensilis, is apparently to be correlated with the sheltered position and the presence of underground moisture relatively near the surface, derived by subsurface drainage from the extensive glade catchment upslope (see p. 35 et seq., Appendix A). Fog-drip may contribute significant amounts of moisture at times.

The open nature of the community as a whole, suggests that succession has not fully culminated although further developmental changes may only take very slowly in view of the sparseness of transgressives. This stand may represent an advanced stage of succession on the site of an old landslip and be slowly developing towards a more closed postclimax Syzygium gerrardii - Other Species Association or S. gerrardii Consociation with increase in numbers of S. gerrardii, Canthium inerme, Maytenus mossambicensis var. mossambicensis, Ochna holstii, Rawsonia lucida, Xymalos monospora and others.

C. THE UPPER HIGH FOREST ZONE

Before concluding this chapter on the Montane or High Forest Belt, the Upper High Forest Zone, which does not fall into Westfalia Estate, will be briefly reviewed. This vegetation zone lies mainly above about 1500 m elevation in the adjacent Grootbosch Government Forest Reserve. The only vegetation which is well represented in this zone is the rank tussock grassveld of the summit plateau or ridge above Rosendal-Frisgewaagd, and the near-climax high forests of the adjoining Escarpment slopes.

PLANT SUCCESSION

1. PRISERES

Successional stages are, for the most part, poorly represented except on the summit plateau, where the vegetation can be regarded as parts of an incomplete lithosere.

THE LITHOSERE

Before considering the lithosere, it will be as well to briefly discuss the geology and its influence on soil formation. Most of the soils of the Escarpment slopes are strongly laterised drift soils underlain by granite-gneiss.

Heavy annual rainfalls under conditions of relatively low evapo-transpiration prevailing in the Humid Medium Tierra Fria and Humid Cool Tierra Templada climatic zones results in relatively high proportions of soil water being available for leaching. Upwards of about the 1500 m level, there appears to be a tendency in places for granite-gneiss, especially the more quartziferous granitic rock, to give rise to leached greyish siliceous soils rather than ferrallitic yellowish red or brown drift soils. The anomaly may be more apparent than real, however, owing to the prevention of the normal course of pedogenesis by surface erosion on locally steep terrain resulting in truncated profiles. Over the more gneissose Archaean rocks and schistose rocks of the Primitive or Basement Systems which appear in the Grootbosch Government Forest Reserve, for instance, a more mature profile may be developed (see Table 15 , p.234).

Some of the soils of this zone, particularly towards the top of the Escarpment are apparently largely residual and derived from the more basic rocks of the Primitive or Basement Systems viz. certain altered and schistose basic igneous rocks, e.g. amphibolite and serpentinite. These soils are shallow and litholic. Although the rocks are still hard and show signs of the original structure, the rocks and saprolites underlying these soils are strongly weathered chemically. Analyses of rock samples from similar soils (Woodbush) have shown that the rocks have almost completely lost their calcium, together with a large proportion of other bases and silica. "Under indigenous forest the soils are often very strongly acid and surprisingly low in exchangeable bases. The humus content is very high and mainly responsible for the relatively high cation exchange capacity. The soils are poorly to weakly structured throughout the profile" (Von Christen, Unpubl.). These soils are grouped with those classified as strongly laterised litholic soils derived from basic igneous rock (see p. 18: (A)/(1)/(1.1)/(b); Table 1 and p. 21). Von Christen (Unpubl.) notes that they have only been observed in the Mistbelt where "even a high stone content is unlikely to affect tree growth adversely". The vegetation of these soils is not considered to differ significantly from that prevailing elsewhere (cf. p.23).

(A) EARLY STAGES

(1) Initial Stages. The only example of the initial stages of the lithosere in the Upper High Forest Zone seen in the area investigated was that provided by a small outcrop of coarse granite-gneiss on the edge of the Escarpment at the eastern end of the large tussock-grassveld glade (*Alloteropsis semialata*-*Harpechloa falx*-Other Species Associes) discussed below (p.231-4). Except for the shade cast by some small trees, viz. *Myrica pilulifera*, the outcrop is fully exposed to sun and wind especially from the east. The site has a high incidence of mist and heavy rainfall. The mean annual precipitation may be in the region of 1750 mm to 2000 mm or more.

The rocks carry a rich growth of crustose lichens together with several foliose lichens and some mosses. The smaller crevices and depressions are colonised by *Senecio othonniformis*, *Cyanotis nodiflora*, *Otiophora cupheoides*, *Panicum natalense*, *Pellaea viridis*, *Vellozia villosa* and *Vernonia monocephala*. Larger crevices are occupied by *Buchnera brevibractealis*, *Cyanotis nodiflora*, *Helichrysum lepidissimum*, *Justicia anagalloides*, *Loudetia simplex*, *Otiophora cupheoides*, *Panicum natalense*, *Pellaea viridis*, *Senecio sceleratus*, *Thesium asterias*, *Vellozia villosa* and *Vernonia monocephala*. These herbaceous plants are accompanied or soon joined by *Myrica pilulifera*.

The foregoing pioneers are joined by the following plants at an early stage:

Aeschynomene rehmannii var.
Alloteropsis semialata
Cineraria fruticetorum
Crassula sp., cf. *C. nodulosa*
C. rubicunda
Cyperus albostriatus
Eriosema polystachyum
Helichrysum chrysargyrum
Pearsonia aristata
Rhynchelytrum repens
Vernonia hirsuta
Aristea ecklonii
Hemizygia rehmannii
Schizocarphus nervosus
Selago elata
Senecio junodii
Combretum kraussii

(2) Broken Rocky Grassveld. The rocky outcrops pass gradually into a broken rocky grassveld composed of the following more conspicuous species:

Loudetia simplex
Panicum natalense
Pellaea viridis
Setaria sphacelata
Buchnera brevibractealis
Cymbopogon validus
Digitaria apiculata
Eragrostis curvula
E. racemosa
Euphorbia striata
Helichrysum adscendens
H. lepidissimum
Indigofera ripae
Justicia anagalloides
Kohautia amatymbica
Schizocarphus nervosus
Selago elata
Tephrosia macropoda
Tryphostemma sp., cf. *T. sandersonii*? [(*T. viride*?)
Vernonia hirsuta
Viola abyssinica
Acalypha schinzii
Aeschynomene rehmannii var.
Aloe boylei
Aristea woodii
Berkheya setifera
Chaetacanthus setiger
Crossandra greenstockii
Cyanotis nodiflora
Gerbera kraussii
Hypoxis sp.
Pentanisia prunelloides
Senecio sceleratus
Sporobolus centrifugus
Stachys sp., cf. *S. rehmannii*
S. nigricans
Themeda triandra
Thunbergia atriplicifolia
T. natalensis
Thesium asterias
Vernonia monocephala
Wahlenbergia virgata

This broken rocky grassveld grades upslope and westwards into the more typical North-Eastern Mountain Sourveld of the top of the spur (see p.231-4).

(B) LATER STAGES

To the north of the northwest corner of the large tussock grassveld glade (*Alloteropsis semialata* - *Harpechloa falx* - Other Species Associes, p. 231 *et seq*.), lies a smaller more xeric glade, sloping to the north and over a more rocky substratum. It has a comparable though rather impoverished species composition, for the most part, and apparently represents a retarded, more seral stage than the large glade although parts are rapidly thickening up owing to invasion and encroachment by subwoody and woody species. The following list includes the more conspicuous plants of this glade:

Plate 39. Southeastern margin of small xeroclinal rocky glade in Grootbosch Government Forest Reserve. Forest margin including *Cussonia spicata* (defoliated) and *Fagara davyi* fringed by *Canthium huillense* with *Vernonia ampla*.

Alloteropsis semialata
Becium knyanum ? (B. obovatum?)
Berkheya setifera
Clutia monticola
Dierama medium
Digitaria apiculata
Eragrostis curvula
E. racemosa
Eriosema cordatum var.
Gerbera kraussii
Harpechloa falx
Helichrysum adscendens
H. fulgidum var.
H. miconiaefolium
H. setosum
Justicia anagalloides
Loudetia simplex
Ornithogalum virens
Pentanisia prunelloides
Rhynchelytrum repens
Schizocarphus nervosus
Senecio coronatus
S. fibrosus
S. sceleratus
Setaria chevalieri
S. sphacelata
Thesium asterias
Thunbergia natalensis
Vernonia hirsuta
V. natalensis
Viola abyssinica
Acalypha schinzii
Aristea woodii
Cymbopogon validus
Cynoglossum sp. (C. lanceolatum?)
Digitaria diagonalis
Disa patula var.
Eragrostis capensis
Eucomis undulata
Eupatorium africanum
Gladiolus woodii
Helichrysum odoratissimum
H. undatum var. agrostephilum
Hypericum aethiopicum subsp.
H. revolutum
Hypoxis sp.
Kohautia amatymbica
Kyllinga cylindrica
Moraea sp.
Nidorella auriculata
Oxalis semiloba
Pelargonium luridum
Polygala virgata
Schoenoxiphium sparteum
Selago elata
Sporobolus centrifugus
Stachys nigricans
Themeda triandra
Thunbergia atriplicifolia
Trachyandra saltii var.
Vangueria infausta
Xysmalobium acerateoides

The margin of the glade in the southeastern corner, where less shade is cast by the surrounding forest, shows the development of a distinct Canthium huillense Consocies, fringing the forest edge. The adjacent forest margin also includes such relatively xeric components as Cussonia spicata and Fagara davyi (see Plate 39). This situation is reminiscent of the Canthium huillense Consocies developed as a subseral stage in the Lower High Forest Zone (see p. 22-4, Appendix A) and the Marginal-Mistbelt C. huillense Consocies (see p. 12-4, Appendix A).

ALLOTEROPSIS SEMIALATA-HARPECHLOA FALX-OTHER SPECIES ASSOCIES

This very rank and tussocky sour grassveld has developed on leached apparently rather siliceous gritty to sandy clay loam under a high mean annual rainfall on top of a spur or ridge of a summit plateau of the Escarpment between about 1550 m and 1600 m elevation.

The grass cover consists mainly of large tussocks of Alloteropsis semialata and Harpechloa falx, accompanied by Cymbopogon validus (especially towards the north), Panicum ecklonii and Sporobolus centrifugus, with occasional small aggregations or colonies of Andropogon filifolius. A concentration of Pteridium aquilinum occurs at the head of a small kloof or depression cutting back into the glade.

The large tussocks form an uneven surface, making passage difficult. Although the main impression gained is of large-tufted grasses, many species of associated grasses, sedges, forbs and woodier plants are also present, sometimes in sufficient quantities as to form seasonal aspect socies. The following list includes the more prominent of the associated species:

Acalypha schinzii
A. wilmsii
Argyrolobium harveyanum
Clerodendron triphyllum
Dierama medium
Digitaria apiculata
Eragrostis curvula
Gerbera kraussii
Helichrysum acutatum
H. adscendens
H. fulgidum var.
H. latifolium
H. platypterum
H. setosum
H. splendidum
Hypericum aethiopicum subsp.
Kohautia amatymbica
Loudetia simplex
Osteospermum caulescens
Senecio speciosus
Stachys sp., cf. S. rehmannii
Thunbergia natalensis
Aeschynomene rehmannii var.
Agapanthus inapertus
Agrimonia odorata
Albuca sp., cf. A. fastigiata
Aloe boylei
Aristea woodii
Asparagus africanus
Becium knyanum?(B. obovatum?)
Berkheya setifera
Buchnera brevibractealis
Clutia monticola
Cyphia elata
Cyrtanthus stenanthus
Dipcadi viride
Eragrostis racemosa
Eriospermum cooperi
Gladiolus sp., cf. G. crassifolius
G. woodii
Helichrysum odoratissimum
H. umbraculigerum
H. undatum var. agrostephilum
Hypericum revolutum (invading)
Hypoxis sp.
Indigofera ripae
Justicia anagalloides
Kniphofia splendida
Lobelia mossiana
L. flaccida var.
Lysimachia ruhmeriana
Moraea sp., aff. M. spathulata
Nidorella auriculata
Ornithogalum virens
Pachycarpus campanulatus
Pelargonium luridum
Pentanisia prunelloides
Pimpinella transvaalensis (dwarfed)
Plectranthus calycinus
Polygala virgata
Psoralea wilmsii
Rhynchelytrum repens
Schistostephium crataegifolium
Schizocarphus nervosus
Schizoglossum pulchellum
Schoenoxiphium sparteum
Scilla sp., cf. S. cooperi
Selago elata
Senecio coronatus
Setaria sphacelata
Silene capensis
Sisyranthus randii
Stachys nigricans
Themeda triandra
Thesium asterias
Tulbaghia alliacea
Vernonia hirsuta
V. natalensis
Viola abyssinica
Wahlenbergia virgata
Asclepias macra (rare)

The southerly margin of the glade is sunny and the shrubby forest fringe varies greatly in composition and in its degree of development. The fringe is usually of mixed composition, consisting of Buddleia salviifolia, Clausena anisata, Hypericum revolutum, Myrsine africana, Rubus sp. and Solanum giganteum, together with occasional Canthium gueinzii, C. huillense, Dioscorea retusa and others. The forest margin

Plate 40. "Island" of forest in tussock-grassveld glade, Grootbosch Government Forest Reserve.

includes such elements as *Allophylus transvaalensis*, *Apodytes dimidiata*, *Bersama* sp., cf. *B. transvaalensis*, *Clausena anisata*, *Cussonia spicata*, *Fagara davyi*, *Ochna o'connorii*, *Prunus africana*, *Rapanea melanophloeos*, *Syzygium gerrardii* and *Trimeria grandifolia*.

The western side of the glade is partially shaded by the trees of the forest margin and scattered forest precursors resulting in an effectively moister, cooler ecoclimate than prevails over the glade to the east. This is suggested by the occurrence of *Alchemilla rehmannii*, *Brachypodium flexum*, *Impatiens duthieae* and *I. sylvicola* , together with much *Stachys* sp., cf. *S. rehmannii* and *Thunbergia natalensis*, with shrubby *Hypericum revolutum*, *Rubus* sp. and also *Cyathea dregei*. Here the forest fringe, consisting mainly of *Hypericum revolutum*, *Rubus* sp. and forest precursors is encroaching on the rank sourveld in which *Cymbopogon validus* is particularly conspicuous. Arborescent and lianoid plants making up the actual forest margin here include *Apodytes dimidiata*, *Canthium gueinzii*, *C. obovatum*, *Cassine eucleaeformis*, *Olea capensis* subsp. *macrocarpa*, *Pavetta lanceolata* and *Xymalos monospora*.

The forest on the northerly margin creates an even more shady and cooler microclimate, especially in winter. The forest-glade margin is abrupt and, except for occasional shrublets like *Andrachne ovalis*, practically no forest fringe is developed. The foliage of the canopy and forest undergrowth extends almost down to ground level. *Aristea ecklonii*, *Impatiens* spp. and *Asplenium splendens* have been seen to occur along the actual margins, which include such facultative understory and shrub-layer components as *Psychotria capensis* and *Maytenus mossambicensis* var. *rubra* and also such canopy trees as *Cussonia spicata*, *Podocarpus falcatus* and *P. latifolius*.

On top of the ridge, quite near the highest point of the glade and close to its northern edge, a small "island" of forest has become established (see Plate 40). *Vernonia ampla* fringes the margins of this forest "island" on the west and on the north, where it is associated with *Andrachne ovalis*. Also fringing the margins, *Hypericum revolutum*, *Plectranthus calycinus* and *Psoralea wilmsii* tend to become more important on the east and on the south.

Canopy components of this forest "island" include *Apodytes dimidiata*, *Cassine papillosa*, *Cussonia spicata*, *Ochna o'connorii*, *Podocarpus latifolius*, *Rapanea melanophloeos* and *Syzygium gerrardii*. A true understory has, for the most part, not yet developed although *Trimeria grandifolia* and *Xymalos monospora* are present, as are the shrubs *Maytenus mossambicensis* and *Peddiea africana*. The field layer is mostly sparse with *Dietes vegeta*, *Oplismenus hirtellus* and *Asplenium* spp. on the floor. Associated lianoid plants are fairly conspicuous and include *Asparagus falcatus*,

TABLE 15. Profile description* of soil pit in ridge variant of mixed high forest, Grootbosch Government Forest Reserve.

Horizon	Depth	Description
A_{oo}		Thin layer of litter.
A_1	0- 18 cm	Brown (7.5YR 4/2) clay loam: weak granular, slightly hard, abundant roots and humus, many small partly decomposed stones (basic igneous rock), pH 4.4
B	18- 38 cm	Brown (7.5YR 4/4) sandy clay: weak blocky, slightly hard, many roots and stones (see above), rich in humus, pH 4.8
C/(B)	38-152 cm	Red yellow (7.5YR 6/6) clay loam: partly decomposed rock <u>in situ</u>, still very hard and structure visible (serpentinite or amphibolite); in fissures: soil (see above) and many roots; pH (soil) 5.0

* Adapted from original tabulated description of Profile 49, H.C. von Christen (Unpubl.)

Behnia reticulata, Secamone alpinii, S. gerrardii and Tylophora flanaganii. Except for epiphytic lichens and mosses, e.g. species of Usnea and Pilotrichella, epiphytes are far from numerous. The only vascular epiphytes seen were Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana.

2. THE CLIMAX

Some forests of the Upper High Forest Zone have already been referred to as being near-climax in status. This is because the Grootbosch forests did not escape exploitation (see 3. THE SUBSERES, p. 250). Nevertheless, the more inaccessible parts of the Grootbosch in the area under consideration are probably relatively undisturbed. There was insufficient time to investigate these forests adequately and only a very concise general account can be given of them here. Before commencing such a necessarily inadequate account of the forests of the Upper High Forest Zone, it may be as well to consider briefly a small part of the forest on ferrallitic soil over altered basic igneous rock a short distance above the western boundary of Rosendal. This portion is situated at about 1500 m elevation in the vicinity of the broad ecotone where the Middle High Forest Zone imperceptibly passes into the Upper High Forest Zone. Von Christen (Unpubl.) has described a soil profile from this site (see Table 15).

(A) RIDGE VARIANT OF TRANSITIONAL MIXED HIGH FOREST

The stand described below is situated near the eastern edge of the forest in the Grootbosch Government Forest Reserve, above the large sour mountain grassveld glade of upper Rosendal, near the watershed between the Madikeleni and Mtataspruit catchments (see p. 35-42 , Appendix A).

(1) Habitat. The slope is moderately steep with a generally easterly aspect. In view of the locality in relation to the surrounding relief and vegetation, the situation is very favourable for the precipication of fog drip from the mist borne on winds blowing in from between northeast and southeast. The rainfall is probably appreciably supplemented by fog drip at times. Precipitation is fairly heavy, probably amounting to between 1500 mm and 2000 mm yearly, and the mean annual rainfall is likely to be in the region of 1750 mm. Although the site is located on a ridge exposed to sun and wind and the surface drainage from the moderately steep slope is likely to be substantial, it appears probable that run-off and evapotranspiration are sufficiently low to leave an

appreciable quantity of the precipitation for leaching. This appears to be borne out by the much-laterised substratum mentioned on p.228-9 (cf. also Table 15). The extreme degree of leaching does not appear to have any detrimental effects on the vegetation, a short description of which follows.

There is little reason to suppose that this stand is in an unnatural condition as a result of disturbance by man or other biotic agency (see Ecological Notes below).

(2) Structure and Composition. This ridge variant of transitional mixed high forest is fairly mature but rather open in structure which can perhaps be ascribed to the exposed and rather stony situation. This openness makes for more clear-cut stratification of the synusiae, of which some seven can be recognised, as set out below:

(a) Canopy. The rather irregularly open to closed canopy varies considerably in height, from about 10 m to nearly 20 m in places. It is composed of *Cryptocarya liebertiana*, *Syzygium gerrardii*, *Cussonia spicata*, *Nuxia floribunda*, *Xymalos monospora*, *Trichilia dregeana*, *Olea capensis* subsp. *macrocarpa*, *Croton sylvaticus* and the hemi-epiphytic *Ficus craterostoma*.

(b) Understory (from about 3 m to about 7.5 m in height). The understory is also rather open and irregular. Apart from *Xymalos monospora* of various sizes, it consists mostly of *Rinorea angustifolia* and *Cassipourea gerrardii*, together with *Teclea natalensis* (and *Oricia* sp.?), *Ochna o'connorii* and *Drypetes gerrardii*. Of these, all but *Rinorea angustifolia* are capable of contributing to the canopy especially where it is rather lower and more open than usual. These typical understory components are accompanied by transgressive *Olea capensis* subsp. *macrocarpa* and other potential canopy trees except *Ficus craterostoma*.

(c) Shrub Layer (from about 1 m to about 2.5 m tall). Shrubs present are *Mackaya bella*, *Piper capense*, *Plectranthus fruticosus*, *Justicia campylostemon* and *Peddiea africana*. True shrubs in this stratum are sparingly accompanied by transgressives of the above-mentioned trees and *Fagara davyi*.

(d) Field Layer (up to about 1 m tall). The field layer is sparse and the herbs and undershrubs are commonly rather subdued in appearance. This stratum is here conveniently treated as one entity. Components of the forest floor include *Clivia caulescens*, *Cyperus* albostriatus, Cardamine africana, Hypoestes verticillaris and the ferns Asplenium erectum and A. splendens, as well as sparingly represented seedlings and small saplings of trees and shrubs.

(e) Lianoid Plants. Except for the few most abundant species, scandent and subscandent plants are not as abundant as in the lower-lying high forests. They fall into two distinct synusiae:

(i) Lianes and Scramblers. Of the more robust and woody climbers helping to knit the rather open canopy together, Canthium gueinzii is the most abundant. Associated species are Cyphostemma anatomicum, Asparagus falcatus and Secamone gerrardii.

(ii) Slender Twiners. The only softer, less robust climbers of note are Tylophora flanaganii and Behnia reticulata.

(f) Hemi-epiphytic Stranglers. Ficus craterostoma in various stages of growth are commonly found on the larger trees.

(g) Epiphytes. The crowns of some of the largest trees carry tresses of fruticose lichens, e.g. species of Usnea and Ramalina, as well as a number of less conspicuous epiphytic lichens lower down. Neckeraceous mosses, viz. species of Neckera , Pilotrichella and Squamidium, are conspicuous apart from the abundant smaller mosses and Jungermanniales on the main stems and lower branches of the larger woody plants. The most conspicuous vascular epiphyte is the fern Asplenium rutaefolium. Associated with it are Trichomanes pyxidiferum var. melanotrichum and Polypodium polypodioides subsp. ecklonii, together with the Angiosperm Peperomia retusa.

(3) Ecological Notes. Not far removed from this soil-pit site are to be found traces of sawpits and "vangkuile" (i.e. pit traps or trench-like pitfalls) testifying that this vicinity is not in a completely undisturbed state. This spot is not far removed from the old wagon road along the crest of the ridge from the plateau down to the Lowveld and the removal of timber would have been a relatively simple matter. Nevertheless, apart from the open structure in parts, which could be due to selective cutting, there is no direct evidence of logging, in the form of saw-pits, stumps or traces of slip-paths, in the immediate vicinity. It seems more likely that timber cutting, if any, in this section of the forest was mainly limited to the selective felling of Brachylaena transvaalensis and Curtisia dentata along the forest margins (by W. McDonald?) (see p. 5).

(B) TYPICAL UPPER MONTANE HIGH FOREST

The forests of the Upper High Forest Zone are more temperate in character than those lower down. Although they may be roughly equally numerous lower down, above about 1500 m elevation Cryptocarya liebertiana is gradually superseded by Syzygium gerrardii. Combretum kraussii, Cussonia spicata and Ficus craterostoma continue to be important in the Upper High Forest Zone. Kiggelaria africana tends to become more important in the canopy with increase in altitude, together with Xymalos monospora. In addition, a number of less numerous potential canopy species enter into the composition of the climax high forests of the Upper High Forest Zone, sometimes becoming more numerous upwards. These usually less numerous, but by no means uncommon, trees include:

Brachylaena transvaalensis
Cassine papillosa
Cassipourea gerrardii (fully grown)
Curtisia dentata (especially margins)
Fagara davyi
Homalium dentatum
Ochna o'connorii
Rapanea melanophloeos
Trichilia dregeana
Apodytes dimidiata

Bersama sp.,cf.B. transvaalensis
Calodendron capense
Croton sylvaticus (especially margins)
Ochna holstii
Olea capensis subsp. macrocarpa
Podocarpus latifolius
P. falcatus
Rothmannia capensis (occasional)
Scolopia zeyheri (occasional)
Drypetes gerrardii (occasional)
Ocotea viridis (scattered)

Croton sylvaticus tends to occur on the more exposed and rocky ridges, often with Syzygium gerrardii, and also along forest margins and in more seral situations.

Besides Cassipourea gerrardii, Ochna o'connorii (and occasional O. holstii), Rothmannia capensis, Xymalos monospora and other potential canopy trees, Diospyros whyteana, Psychotria capensis, Oxyanthus gerrardii, Rinorea angustifolia and Tricalysia capensis are typical of the understory at higher elevations, with Canthium obovatum, Clausena anisata and Trimeria grandifolia especially near the margins.

Typical shrubs include Justicia campylostemon, Mackaya bella, Piper capense, Plectranthus fruticosus, Sclerochiton harveyanus and Vernonia umbratica with Eugenia natalitia and Peddiea africana near the lower margins.

The field layer is usually sparse. Apart from local aggregations of Dietes vegeta, Hypoestes verticillaris, and, periodically, Isoglossa delicatula, Oplismenus hirtellus and Pteris catoptera occur sporadically. Cardamine africana and Plectranthus dolichopodus may be present to locally abundant on more disturbed sites. Pseudobromus africanus is infrequently scattered on the forest floor, as are Asplenium erectum and A. lobatum with other facultatively epiphytic species of Asplenium, Clivia caulescens and Streptocarpus parviflorus, sometimes fallen from the crowns.

Lianoid plants are frequent, but apparently not as abundant as in the Middle High Forest Zone. The more robust and woody lianes and scramblers include Asparagus falcatus, Canthium gueinzii, Clematis brachiata, Cnestis natalensis, Cryptolepis capensis, Cyphostemma anatomicum, Mikania cordata, Mikaniopsis sp., Rhoicissus rhomboidea, R. tomentosa, Secamone gerrardii, S. alpinii and Strophanthus speciosus. Slender twiners include, especially, Behnia reticulata and Tylophora flanaganii, together with occasional Senecio tamoides and Solanum bifurcum, particularly under canopy openings, where Cuscata kilimanjari may parasitise species of Plectranthus and Acanthaceous shrubs and undershrubs.

Hemiparasitic epiphytes are apparently extremely rare unless one includes species of Usnea in this synusia. Loranthus dregei is the only vascular plant seen in this niche.

The only hemi-epiphytic strangler is Ficus craterostoma, abundantly represented in various stages of its development.

Cryptogamic epiphytes are abundant. Besides foliose and fruticose lichens in the crowns, foliose lichens, especially, occur lower down on the bark of stems e.g. Lobaria pulmonaria. Bryophytes clothing the stems are extremely abundant, for instance Jungermanniales and numerous mosses like Cryphaea exigua and Neckeraceae , particularly where the canopy crowns are not too dense, when abundant strands of species of Pilotrichella festoon the stems and branches, especially of understory trees and shrubs. Short-stemmed mosses such as Leucoloma rehmannii, are also locally abundant lower down on the boles of the larger older trees, e.g. Syzygium gerrardii.

The most numerous vascular epiphytes are ferns, particularly Asplenium rutaefolium, accompanied by Polypodium polypodioides subsp. ecklonii, Pleopeltis excavata and P. macrocarpa, and, especially in the more misty situations, Trichomanes pyxidiferum var. melanotrichum. Other epiphytic ferns are Asplenium anisophyllum, A. erectum, occasional A. gemmiferum (usually near water) and A. lobatum. Besides young Ficus craterostoma and Cussonia spicata seedlings and saplings, epiphytic Angiosperms include Peperomia retusa, P. reflexa and Polystachya ottoniana colonies, with scattered Polystachya transvaalensis and Streptocarpus parviflorus, and occasional colonies of Bulbophyllum sandersonii.

3. THE SUBSERES

The sites of the old waggon roads, larger saw-pits and encampments are now occupied by a tangle of Plectranthus fruticosus bound together by species of Rubus and Secamone, Tylophora flanaganii and other climbers, with Cuscuta kilimanjari parasitising P. fruticosus. Most of the larger and better-formed yellow-woods (Podocarpus spp.) appear to have been cut out wherever accessible. The same probably also applies to Olea capensis subsp. macrocarpa and possibly Prunus africana, and perhaps also to large Apodytes dimidiata, Bersama sp., cf. B. transvaalensis, Brachylaena transvaalensis, Cassipourea gerrardii, Curtisia dentata, Drypetes gerrardii, Homalium dentatum, Ocotea viridis, Rapanea melanophloeos and Syzygium gerrardii (Hutchins, 1903; Lane-Poole, 1909; W.M. Botha, p.c.). Some trees, e.g. Homalium dentatum, appear to have since sprouted from stumps to become canopy components once again. High local concentrations of less valuable trees, e.g. Cussonia spicata and Xymalos monospora (Stapleton, 1937), appear to be, in part at least, another result of this selective felling.

CHAPTER VII

MARGINAL MISTBELT

On the immediate outskirts of the Middle High Forest Zone along the crest of the Rakgwale Ridge, the Low-Country vegetation of the rain shadow to the north extends upwards to form an abrupt ecotone, edging the Mistbelt to the south of the ridge. The Mistbelt-forest vegetation of the mesocline is separated by a narrow strip of Marginal-Mistbelt communities from the xeroclinal Low-Country type of vegetation. As in the case of the more typical zonal vegetation, these marginal communities are discussed in roughly successional order. The most advanced successional stage is somewhat plagioseral, at least in parts, having been subjected to a measure of disturbance over a long period, but it is included here in the absence of any completely undisturbed communities of higher status and because it is presumed to approximate natural stages of primary succession. The adjacent plagioseral grassveld and subseral scrub are discussed in Appendix A (p. 10-14).

PLANT SUCCESSION

A. PRISERES

LITHOSERES

1. XEROCLINAL LITHOSERE

Habitat. On the north face of the peak of Spitskoppie, close to the northwestern-corner boundary of Christinasrust, the xenolithic rock of the Primitive or Basement Systems crops out in more or less unbroken sheets of rather limited extent. The surface of the mostly schistose rock (amphibolite, talc and serpentine schists) is not conspicuously foliated here for the most part, although seams are visible in places, resulting in local irregularities on the surface of the substratum. The rock face slopes steeply, roughly to north-northwest and is therefore fully exposed to the sun for most of the hottest part of the day. The rock is mostly dark in colour and can frequently be heated up to high temperatures during the day. The bare rock surface is thus, physically, a very inhospitable substratum, the steep slope resulting in much-reduced penetration and high run-off and evaporation of rainfall. Evapotranspiration is further increased by exposure to wind, especially the desiccating winds from over the warm, dry Mokeetsi- or Koedoes-River

Plate 41. Lithosere on north face of Spitskoppie on Rakgwale Ridge, Christinasrust (-Enkeldedoorn).

Valley and the Lowveld to the northwest, north and northeast. The incidence of mist and heavy dew is probably rather low and irregular, compared with the mesoclinal slopes but, nevertheless, highly significant for the survival and establishment of seedling pioneer chasmophytes. The substratum may also be chemically inimical in places, e.g. owing to the presence of serpentinitic rock, but no definite information is available on this point.

Early Stages. Few species appear to be adapted to colonising the bare rock, even in crevices. *Vellozia villosa* is the most conspicuous pioneer in crevices. It is accompanied and followed by *Scilla natalensis*, *Notholaena eckloniana*, *Pellaea calomelanos*, *P. viridis*, *Rhynchosia komatiensis*, *Acalypha punctata*, *Helichrysum nudifolium* var. *quinquenerve* and *H. odoratissimum*. These herbaceous and shrubby plants are, in turn, accompanied or followed by seedlings of trees, viz. *Faurea speciosa*, *Heteropyxis natalensis*, *Acacia ataxacantha*, *Catha edulis*, *Ficus capensis* and *Pterocarpus rotundifolius* (see Plate 41).

No later stages were observed. It seems that the site may gradually be ameliorated as a result of the shade and shelter provided by the trees, resulting in the eventual closing of the subsequent lithoseral communities by more widespread colonisation, but this remains conjectural. Of particular significance is the presence of woody and subwoody elements more typical of Low-Country vegetation at over 1400 m elevation, viz. *Faurea speciosa* and *Pterocarpus rotundifolius* with *Argyrolobium transvaalense* and *Rhynchosia komatiensis*.

2. MESOCLINAL LITHOSERE

GREYIA RADLKOFERI-OTHER SPECIES ASSOCIES

(A) HABITAT

The small stand described here is situated on the steep south-facing slopes just below the summit "peak" of Spitskoppie on the Rakgwale Ridge close to the northwestern-corner boundary of Christinasrust (see Plate 42). The altitude is about 1425 m. The slope varies from steep to very steep, the aspect being mostly south-southeasterly. The site is fully exposed to all winds except those from between north and northwest. The crag-like slope faces into the winds from between south and east which often bring mist and moisture. This spot probably lies within a partial rain shadow cast by Piesang Kop.

The substratum is predominantly schistose xenolithic rock. The

Plate 42. Mesoclinal slopes of Spitskoppie, Rakgwale Ridge, Christinasrust, with mesoclinal lithoseral woodland just below the peak.

meagre soil, where present, is matted with roots. It is very shallow and consists mostly of humus and leaf mould.

(B) STRUCTURE AND COMPOSITION

This stand can be considered to be a closed-canopy community. Stratification is not clearly evident, owing to the obscuring effect of the steep slope and the poor development of certain strata, but some five synusiae can be distinguished as detailed below:

(1) "Canopy". The low and irregular "canopy" of small and dwarfed trees and large shrubs up to 3 m to 4 m tall is more or less closed. The components are more or less closely spaced horizontally, with their crowns spreading outwards to the south and overlapping in a fashion comparable to that of the *Curtisia dentata* Consocies (see p. 206 *et seq.*). Constituent species include *Greyia radlkoferi*, fully grown *Peddiea africana*, *Psychotria capensis* and *Tricalysia capensis*, with occasional *Combretum kraussii*, *Curtisia dentata*, large *Maytenus mossambicensis* var. *mossambicensis*, *Nuxia congesta* and *Rapanea melanophloeos*.

A true shrub layer appears to be absent although several transgressive trees 1 m to 2 m tall overtop the field layer.

(2) Field Layer.

(2.1) Undershrubs and Taller Subwoody Herbs. The more abundant species of this subclass are *Plectranthus arthropodus*, *Helichrysum odoratissimum*, *Cineraria fruticetorum* and *Plectranthus laxiflorus*, with occasional *Sparmannia ricinocarpa* and *Stachys grandifolia*.

(2.2) Smaller Herbs and Ferns. This sublayer consists chiefly of the following species:

Oplismenus hirtellus
Crassula thorncroftii
Cyperus albostriatus
Cheilanthes hirta
Streptocarpus parviflorus
Agapanthus inapertus
Asplenium aethiopicum
Dietes vegeta
Dryopteris inaequalis
Clivia caulescens
Pellaea quadripinnata
P. viridis
Satyrium parviflorum
Liparis neglecta
Mohria caffrorum
Wahlenbergia madagascariensis

(3) Ground Layer. The ground layer is well developed lower down, i.e. away from the influence of desiccating northerly to westerly winds sweeping over the summit of the "peak", with numerous Jungermanniales and mosses, including *Rhodobryum* sp.

(4) Lianoid Plants. The synusia of scandent plants is poorly developed. It is composed largely of Riocreuxia picta, Senecio tamoides, Behnia reticulata, Jasminum streptopus var. transvaalense and Vernonia mespilifolia, with occasional Asparagus falcatus, Rhoicissus revoilii, Smilax kraussiana and Sphedamnocarpus galphimiifolius.

(5) Epiphytes. Epiphytic plants, especially lichens, are surprisingly poorly represented in view of the apparently favourable situation. It is possible that the site is too windy for the lodging of disseminules and the easy establishment of plantlets. The more frequent epiphytes here are Polystachya ottoniana, Peperomia reflexa, Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and the moss Neckera valentiniana.

(C) ECOLOGICAL NOTES

This small community gives evidence of varied affinities. The field and ground layers reveal a relationship with the mesoclinal lithoseres of the Lower High Forest Zone (cf. p.165-7), e.g. Rhodobryum sp., Cheilanthes hirta, Plectranthus arthropodus and Satyrium parviflorum. The trees show affinities with the nearby Marginal-Mistbelt and High-Forest Belt forest communities (cf. p.244-50 & 217-23): e.g. in the presence of Podocarpus latifolius (transgressives), as well as with the mesoclinal lithoseres of the High Forest Belt, e.g. Greyia radlkoferi and Myrica pilulifera (transgressives).

Scrutiny of old photographs (e.g. Plate 48) discloses that there has been a marked increase in the larger woody plants over the past twenty years. The indications are that the succession is proceeding slowly in the direction of a preclimax community of rather stunted and scrubby Marginal-Mistbelt forest composed of the following trees and large shrubs:

Psychotria capensis
Rapanea melanophloeos
Peddiea africana
Curtisia dentata
Tricalysia capensis
Greyia radlkoferi
Pittosporum viridiflorum
Podocarpus latifolius
Maytenus peduncularis
(Drypetes gerrardii?)

Rhus chirindensis forma
Trimeria grandifolia
Apodytes dimidiata
Buddleia salviifolia
Canthium inerme
Combretum kraussii
Maytenus heterophylla (margin)
M. mossambicensis var.
Myrica pilulifera
Nuxia congesta

Below the stand just described, the vegetation merges into a stand of scattered larger trees and shrubs bound together by a wealth of lianoid plants (see Plate 42). In general physiognomy, especially the luxuriant growth of lianoid vegetation (e.g. Coccinia variifolia), as well as in the steep mesoclinal slope and probably rather unstable, rocky and bouldery substratum, this latter stand resembles the Nuxia floribunda-Other Species Associes or "Cliff Forest" of mesoclinal craggy slopes and scree of the Lower High Forest Zone (see p. 174 et seq.; cf. Plates 42 & 30,p.175). The species composition is probably rather different except perhaps for the lianoid flora. The composition was not investigated, but Cussonia spicata seems to play a prominent part. This undescribed community can be considered to fall into the Middle High Forest Zone.

B. SUBCLIMAX? (OR PLAGIOCLIMAX?)
CUSSONIA SPICATA - OTHER SPECIES ASSOCIES OR ASSOCIATION

This heterogeneous scrubby Marginal-Mistbelt forest is found along the top of the Rakgwale Ridge, just south of the northern boundary firebreak of Weltevreden, Enkeldedoorn and Christinasrust. The following description is based on the best-developed portions remaining. These can be regarded as consisting of an eastern and a western section interrupted by Spitskoppie. Although the eastern and western sections differ in a number of respects, it is convenient, for the purposes of this account, to treat them as variants of a single entity.

1. HABITAT

The stands studied are situated between about 1350 m and 1450 m elevation. The slope varies from level to locally steep. The aspect is variable but, for the most part, roughly about southeasterly. The sites are exposed to wind from all quarters. The northern margins are exposed to periodic hot, dry winds from the north, northwest and northeast, as well as to much intense sunshine all the year round. On the north, the forest is bounded mainly by the northern boundary firebreak. To the south it merges locally, especially on parts of Christinasrust and Enkeldedoorn, into climax high forest (Trichilia dregeana-Croton sylvaticus-Cussonia spicata, p. 217 et seq.). Elsewhere, it is bounded on the south by scrub forest, scrub and pine plantations (formerly glades).

The mean annual precipitation is probably quite heavy, possibly of the order of 1500 mm, but the site is likely to be characterised by long drought periods. The periodic, long dry spells are sometimes tempered by mist and moisture-bearing winds but this slight moderation of climate is probably offset by exposure to warm dry winds.

Soils vary a great deal but they are mostly shallow and rather

Plate 43. View along Christinasrust-Kranskop boundary towards Kort Hannie-Piedmont boundary, Rakgwale Ridge, showing inroads on forest remnants towards the right.

Plate 44. Inroads being made on forest remnants by encroaching Bantu maize lands, Rakgwale Ridge, Christinasrust. Trees left standing are <u>Trichilia dregeana</u>, <u>Ficus craterostoma</u>, <u>Celtis africana</u>, <u>Cussonia spicata</u> and <u>Trema orientalis</u>. Northern slopes of Piesang Kop in background.

immature residual soils whose character is largely determined by the parent rock. Along the top of the ridge, the underlying rocks are mostly xenolithic amphibole-, talc- and biotite- "schists" with widely scattered diabase dykes cropping out in places. Farther downslope, isolated small outcrops of granite-gneiss may occur. The amount and quality of litter and duff vary a great deal. In parts the soils are very humiferous. Erosion and run-off can be considered negligible. Even after exceptionally heavy rains the surface flow is much impeded and controlled by litter and duff, matted with roots and rootstocks.

The local Bantu have probably intermittently cultivated small patches within the forest from time immemorial. These remain as scrubby open-canopy portions for many years. The Marginal-Mistbelt and typical montane high forests along and to the south of the Christinasrust-Kranskop boundary, to the east of the Westfalia Estate portion of Christinasrust, have largely been cleared. In addition to the initial clear-felling of 1917-18 (see p. 5), the Bantu of Kranskop and vicinity appear to have cleared some primary forest as well as the cut-over areas for crop-lands (see Plate 43). In spite of the fact that the forest south of the ridge falls into Westfalia Estate, intermittent selective cutting continues. Bantu cultivation of maize also appears to have encroached on the property of Westfalia Estate (see Plate 44).

Grazing of stock along the firebreak has resulted in the frequent incursion of stock over the boundary, into the forest margin. This happens more often in winter and early spring and during drought periods, when grazing is scarce and when forest plants are also most vulnerable. This disturbance has taken place particularly on the northern corner of Christinasrust where the poor development of strata between the canopy and the forest floor attests to the degree of local trampling and browsing.

Game, e.g. bushbuck and red duiker, was probably once quite plentiful along this ridge but poaching has both reduced and driven away game.

Apart from the northern boundary firebreak which is annually burned and bared, no burning takes place south of the boundary. Fires have taken place in the past, however, as evidenced by the signs of charring shown by some of the larger trees.

2. STRUCTURE AND COMPOSITION

This is a closed-canopy community for the most part. Stratification is usually evident. Some four synusiae, at least, can be easily distinguished although more are present as set out below:

(A) CANOPY

Although mostly closed, the canopy is rather open in parts becoming low and ragged on the northern margin. The trees are typically irregularly spaced. The canopy varies considerably in height: from about 5 m tall towards the northeast, to over 15 m, towards the Escarpment in the southwest. This stratum is correspondingly heterogeneous in floristic composition as can be seen in the following list. The letters E, W and M in parentheses denote that the species concerned tend to be more common towards the east, the west and the northern (firebreak) margin respectively. The canopy is dominated for the most part by *Cussonia spicata*. Associated canopy trees include the following:

Maesa lanceolata (WM)
Trimeria grandifolia (E)
Halleria lucida
Brachylaena transvaalensis
Ficus craterostoma
Rapanea melanophloeos (E)
Allophylus transvaalensis (M)
Celtis africana (M)
Combretum kraussii
Cryptocarya liebertiana
Euclea crispa (M)
Homalium dentatum
Kiggelaria africana
Large *Maytenus* sp.?(*M. heterophylla* [subsp.?) (M)
Nuxia congesta (W)
N. floribunda (W)
Rhus chirindensis forma (E)
Ziziphus mucronata (M)
Acacia ataxacantha
Apodytes dimidiata
Calodendron capense
Calpurnia aurea
Cassine papillosa (E)
Catha edulis (EM)
Croton sylvaticus
Curtisia dentata
Fagara davyi (often M)
Ficus capensis (M)
Heteromorpha trifoliata (M)
Ilex mitis
Pittosporum viridiflorum
Prunus africana
Scolopia zeyheri
Teclea natalensis
Trema orientalis (M)
Trichilia dregeana
Xymalos monospora

(B) UNDERSTORY

Besides the often very numerous transgressive potential canopy trees, the understory (2 m to about 5 m tall) consists of the following small trees and large shrubs. *Trimeria grandifolia* dominates this layer in the eastern section where it is associated with *Maytenus mossambicensis* var. *mossambicensis* as subdominant. Like *Xymalos monospora*, both of these species can reach the canopy where it is low. Associated typical understory components are *Clausena anisata* (WM) and *Xymalos monospora*, accompanied by *Eugenia natalitia*, *Grewia occidentalis* and *Rinorea angustifolia*, with occasional *Canthium huillense*, *C. inerme*, *Greyia radlkoferi* (towards Spitskoppie), *Psychotria capensis* and *Tricalysia capensis*.

(C) SHRUB LAYER

Apart from the numerous transgressive trees, this stratum (1 m to about 2 m in height) is poorly represented. The more numerous shrubs proper are Andrachne ovalis (localised), Piper capense, Plectranthus fruticosus, Peddiea africana, Carissa bispinosa var. acuminata and Vernonia ampla (M), with occasional Mackaya bella, small Maytenus sp.? (M. heterophylla subsp.?) (M) and Solanum giganteum (WM).

(D) FIELD LAYER

(1) Low Soft Shrubs, Undershrubs and Tall Subwoody Herbs and Ferns (up to about 1 m tall). This sublayer is dominated by the Acanthaceous undershrub Hypoestes verticillaris. It is accompanied by Desmodium repandum, Asparagus virgatus, Hypoestes aristata, Pouzolzia parasitica, Adenocline mercurialis, Argyrolobium tomentosum (often forming a fairly extensive fringe along the northern margin with Lippia javanica), and Fleurya mitis. Also present are occasional Phaulopsis imbricata , Pteridium aquilinum (M), Sparmannia ricinocarpa and Stachys grandifolia.

(2) Low Herbs and Ferns. Oplismenus hirtellus dominates this sublayer. Associated species are Dietes vegeta (E), Setaria chevalieri (localised), Galopina circaeoides, Pteris catoptera (rather undersized), Haemanthus magnificus, Cyperus albostriatus, Achyranthes aspera, Chlorophytum comosum, Lapeirousia grandiflora, Schoenoxiphium sparteum, Agapanthus inapertus, Australina acuminata, Panicum monticolum, Pellaea viridis and Sanicula elata.

(E) LIANOID PLANTS

(1) Lianes and Scramblers. The most abundant woody liane appears to be Rhoicissus rhomboidea. Among the more numerous associated species of the larger and more woody lianoid plants serving to knit the canopy together are the following:

Jasminum streptopus var.	Mikania cordata
Rhoicissus tomentosa	Clematis brachiata
Cyphostemma anatomicum	Adenia gummifera
Pyrenacantha grandiflora	Cephalanthus natalensis
Secamone gerrardii	Smilax kraussiana
Asparagus falcatus	Vernonia mespilifolia
Cryptolepis capensis	Senecio tamoides (occasional E)
Secamone alpinii	Toddalia asiatica (very localised, W)

(2) Softer Slender Climbers. The most numerous slender twiner, especially towards the west is Behnia reticulata. Associated with it are Tylophora flanaganii and Solanum bifurcum, accompanied by Senecio

tamoides, Coccinia variifolia (M), small Jasminum streptopus var. transvaalense, Cissampelos torulosa, Dioscorea retusa, Ipomoea wightii, Riocreuxia torulosa and R. picta, with occasional Rhynchosia caribaea, Senecio deltoideus and Stephania abyssinica, together with isolated Sphaerostylis natalensis (very localised, W).

(F) HEMI-EPIPHYTIC STRANGLERS

All sizes of the (facultatively) epiphytic transgressive stages of Ficus craterostoma are commonly found on most fair-sized trees. Many of the fully grown canopy trees, especially along the northern margin could conceivably have originally germinated in soil.

(G) EPIPHYTES

Epiphytic lichens (e.g. species of Ramalina and Usnea) are locally abundant, especially in the crowns of the more exposed canopy trees and along the northern to western margins of the patches of this marginal forest. Neckeraceous mosses in particular, are locally conspicuous on the trunks and lower branches of the larger and older trees. Vascular epiphytes, in approximated descending order of abundance, include Polypodium polypodioides subsp. ecklonii, Polystachya ottoniana, Peperomia retusa, Pleopeltis macrocarpa, Asplenium rutaefolium, Tridactyle tricuspis and occasional Peperomia reflexa.

In addition, facultatively hemi-epiphytic seedlings and saplings of all sizes of Cussonia spicata frequently occur in crotches of trees and on top of old stumps especially near the ground. Dietes vegeta also occurs rather rarely as an epiphyte or hemi-epiphyte in crotches.

(H) EPIPHYTIC HEMIPARASITES

The rather shrubby epiphytic hemiparasitic Loranthus dregei is rare. The hemi-epiphytic, hemiparasitic slender twiner Cassytha ciliolata occurs sporadically in the more scrubby portions marginal to scrub and scrub forest.

3. ECOLOGICAL NOTES

Local aggregations of Catha edulis and, to a lesser extent, of Trema orientalis occur along the northern margin and in places where the canopy has been opened, probably usually owing to disturbance. Local aggregations of seedlings and saplings of Psychotria capensis occur under closed canopy in apparent absence of disturbance. This would seem to indicate that, if undisturbed, a fringe of small trees and shrubs will develop just inside the forest margin to complement the lower fringe developing outside the northern to northwestern margins and advancing towards the firebreak. The outer fringe consists largely of Argyrolobium tomentosum and Lippia javanica, with occasional Hypericum revolutum and the lianoid Coccinia variifolia, Ipomoea wightii, Rubus pinnatus and Smilax kraussiana. Local aggregations of Dietes vegeta and Ficus capensis apparently arise mainly owing to vegetative reproduction.

More or less buttressed and fluted trunks are exhibited by Calodendron capense, Celtis africana, Cryptocarya liebertiana, Cussonia spicata, Drypetes gerrardii (transgressive), Ficus capensis, F. craterostoma, Homalium dentatum, Ilex mitis, Nuxia congesta, Scolopia zeyheri and Trichilia dregeana in particular.

The Marginal-Mistbelt forest patches can, for the most part, apparently be regarded as representing subclimax stages in the development of a climax Montane High Forest under limiting conditions, the northeastern section having a somewhat lower status than the southwestern section. The limiting conditions which prevent the attainment of a normal climax Montane High Forest are notably the exposure to long dry periods, warm dry winds and intense sunshine, in combination with the rocky substratum.

It seems probable that the composition of the Marginal-Mistbelt forests will gradually undergo slight change towards something more akin to the normal climax montane high forests in composition, but likely to differ in the following respects:

(1) Canopy: a greater proportion of Cussonia spicata, Brachylaena transvaalensis, Ficus craterostoma, Rapanea melanophloeos, Allophylus transvaalensis (M), Maesa lanceolata (M), Homalium dentatum, Calpurnia aurea (M) and Celtis africana, but less Trichilia dregeana, Croton sylvaticus , Cryptocarya liebertiana and Xymalos monospora;

(2) Understory: more Halleria lucida, Trimeria grandifolia, Clausena anisata, Allophylus transvaalensis, Psychotria capensis, Tricalysia capensis and, possibly, Maesa lanceolata and Maytenus mossambicensis var. mossambicensis, but less Cassipourea gerrardii, Oxyanthus gerrardii, Rawsonia lucida and Rothmannia capensis ;

(3) Shrub Layer: possibly more Carissa bispinosa var. acuminata and Plectranthus fruticosus (and Peddiea africana) and less Piper capense and Machaya bella;

(4) Field Layer: more Asparagus virgatus, Hypoestes aristata, Galopina circaeoides, Setaria chevalieri and Argyrolobium tomentosum (M)

CHAPTER VIII

THE VEGETATION IN RELATION TO CONSERVATION AND RECLAMATION

In the introductory chapters (p. 4 *et seq.* & p. 41 *et seq.*), mention was made of the exploitation of the timber resources of the area by White settlers, of how the Bantu inhabitants practised shifting cultivation and stocking and how the White settlers' attempts at intensive European-type crop-farming had been unsuccessful. It was pointed out that yields could not be sustained by either Bantu or White farmers and that stock-farming was generally unprofitable largely owing to the poor sourveld grazing. The land-use pattern found to provide the most sustained high yields exploited the more stable conditions required and preserved by farming with trees, viz. the establishment of eucalypt and pine plantations, and citrus and avocado orchards. The planting of native and introduced plants to conserve, reclaim and improve vegetation, soil and water resources endangered by exploitation has also been mentioned previously (see p. 10-11 & p. 44 *et seq.*).

Afforestation with indigenous and exotic species in relation to conservation and reclamation of water and soil resources is considered in more detail in this chapter. Eucalypts were first used for soil reclamation, but a more original venture was the attempt to improve both soil and water resources by means of plantations of *Trema orientalis*. The latter project will be considered first.

A. TREMA PLANTATIONS

Because eucalypt plantations were suspected of being implicated in the increasing shortage of water, Merensky wondered about the possibilities of afforestation with an indigenous tree that would presumably use less water than the eucalypts and so permit better replenishment of ground-water resources.

During the early and mid-forties, plantations in the catchment area were alleged to be responsible for the reduced flow of the Brandboontjies River (near Duiwelskloof) and the possibility of expropriating this land, if need be, was mooted (Lehmann, 1959; J.D.M. Keet, p.c.). After hearing conflicting views, Merensky decided to take action on his own, which he hoped would resolve the dispute or, at least, increase or stabilise the flow of the Brandboontjies River. While negotiations for the purchase of those portions of the farms Christinasrust and Korthannie, which included parts of the upper catchment and headwaters of the Brandboontjies River, were in progress, plantations above the

Plate 46. Trema plantation, Compartment 29c, Westfalia, on top of ridge. Poor growth of T. orientalis with seedling *Eucalyptus grandis and *Acacia mearnsii. Associated grasses are Setaria chevalieri, Hyparrhenia species, Panicum maximum, S.sphacelata and Eragrostis curvula.

source area on Christinasrust were felled and the lower, steeper slopes were contour-trenched at short intervals to effect nearly complete penetration of rainfall (see Plates 45 & 48, p. 259). From 1945 to 1947, plantations of Trema orientalis were established on Christinasrust (Keet, 1962; Wicht, 1949). From about that time until 1950, the slopes of Central Hill below the Mistbelt were planted to T. orientalis.

The choice of T. orientalis was not a haphazard one but the outcome of a thorough search for a tree which had to satisfy several requirements. Clearly the tree selected had to be a pioneer species capable of growing well in the open, exposed to sun and wind. Moreover, it had to improve the soil in the same way as the eucalypts (see p. 269 et seq.). At the same time, it ought to furnish a reasonable supply of commercially valuable timber in a reasonable period of time, if possible, so that it had to be a fast grower. As a rapidly growing semideciduous pioneer normally forming a straight bole, T. orientalis suggested itself for the purpose. Its habit of casting off leaves, twigs and lower branches, sufficiently soft for rapid decomposition, further recommended it as a generous provider of organic matter for incorporation in the soil. It was also known to provide timber suitable for box shooks and cabinet work. However, the main consideration was that the Trema plantations were to be integrated in the soil- and water-conservation and improvement programme (Keet, 1962), especially on degraded and plantation sites on the dissected slopes of the foothill and montane topographic belts.

Litter was allowed to accumulate in the Trema plantations to ameliorate conditions for the soil micro-organisms. After a few years, it became apparent that the Christinasrust Trema trees had to be replaced by second-stage pioneer trees as they died out, or the plantations would become irregularly open and of limited value for site-improvement, not to mention commercial timber production. Seed was collected, a special indigenous-tree nursery was begun and underplanting of Compartment 12, Christinasrust, was carried out with some 4000 trees in 1952-53. This underplanting ceased soon after Merensky's death as it has since been thought that haphazard infiltration by later-stage high-forest trees might be sufficient to render artificial underplanting unnecessary (W.M. Botha, p.c.; J.D.M. Keet, p.c.; S.C. McDonald, p.c.).

Opinion as to the success or failure of the project must necessarily be divided on different issues, owing to the divergent aims pursued and because the Trema plantations fall into two distinct groups, namely:

(1) the plantations on Westfalia and Sarahsdrift below the Mistbelt on the lower eastern to northern slopes of the Central Hill; and

(2) the Christinasrust plantations in the Mistbelt.

Plate 46. Trema plantation, Compartment 29c, Westfalia, on top of ridge. Poor growth of T. orientalis with seedling *Eucalyptus grandis and *Acacia mearnsii. Associated grasses are Setaria chevalieri, Hyparrhenia species, Panicum maximum, S.sphacelata and Eragrostis curvula.

These plantations will first be discussed in that order, followed by a general review of the objectives and theoretical and practical considerations implicit in Merensky's efforts to conserve and improve the water and soil resources of the Estate.

1. THE CENTRAL HILL TREMA PLANTATIONS

(A) LOCALITY AND HABITAT

The remaining Central Hill Trema plantations fall into four sections, viz. Compartments M.F. and 29c, and W.W. and 30 on Westfalia and Sarahsdrift. The altitude varies from about 950 m up to about 1050 m, i.e. the plantations lie just below the Mistbelt, as arbitrarily delimited, and low-lying fog is experienced relatively rarely. The aspect changes from almost southerly in parts (Compt. M.F.) through southeasterly (Compt. M.F.) to easterly (Compt. 29c) to between northeasterly and northerly (Compts. 29c, W.W. and 30). The more northerly to westerly aspects fall into the Low Scrub Forest Zone while the more easterly to southerly parts are transitional to the High Scrub Forest Zone. The mean annual rainfall appears to be ample but the distribution is erratic, especially during winter and spring when the plantations may be exposed to hot and dry or cooler, dry to moister conditions depending on local relief. The topographically controlled ecoclimate and also soil quality have played a decisive rôle in determining the local measure of success or failure of the plantings. The growth on the south-facing slopes and in the bottoms of small kloofs and gullies has been conspicuously better than on the more exposed, rocky, north-facing slopes where the soil is shallow and drier most of the time (cf. Plates 47 and 46).

The underlying rock consists mostly of deeply weathered granite-gneiss dissected by several diabase dykes forming rocky ridges with bouldery outcrops. The soils vary in texture, structure and humus content, as well as in depth and maturity and degree of leaching following differing degrees of cultivation and protection. The depth of surface litter and duff, as well as the humus content vary a great deal in accordance with the site and its past history. At one extreme are impoverished soils of poor physical structure with fair amounts of litter but little humus, on old cultivated-land sites on ridges and upper slopes with more or less northerly exposure and presumably more rapid oxidation of humus. On the other hand, there are deeper, more mature and less disturbed soils of good granular structure and higher humus content, in the moister, cooler and less exposed sites at the bottoms of the small

Plate 47. North-facing small kloof in *Trema* plantation, Compartment 29c, Westfalia. Taller *T. orientalis* with *Bauhinia galpinii* scrambling and *Vernonia ampla*, together with robust *Setaria chevalieri*.

kloofs and on the more easterly to southerly slopes.

The slopes vary from occasionally slight to usually moderate to steep. Run-off from the steeper slopes may be high after heavy downpours but little erosion takes place now. The load carried by sheet erosion usually goes no farther than the next contour furrow downslope.

Termites abound, especially where there are the most Trema failures and dead wood. Their activities have probably helped appreciably to improve the infiltration capacity, aeration and physical structure of the soil. Fairly extensive areas of soil pellets may be found in the vicinity of isolated large ant nests (e.g. colonies of Streblognathus aethiopicus) which presumably bring about far-reaching, if localised, improvements in the crumb-structure of the soil.

Different sections of these plantations have been subjected to different treatments in the past, the history of each compartment being briefly as follows:

(1) Compartment M.F. The "Merensky Fountain" Compartment was formerly occupied by resident Bantu workers and their families with their cultivated and grazed lands. The poor infiltration of the old crop-lands and other disturbed areas was held to be the cause of cessations in the flow of a small spring in a steep kloof. After evacuation of the site, different portions were planted to Trema orientalis in 1946, 1947 and 1950. The lower portion has since largely been converted to citrus orchards.

(2) Compartment 29c. Much of this compartment was unsuccessfully planted to *Acacia mearnsii during the period of ownership by Harold Lionel Phillips. It was subsequently replanted with *Eucalyptus grandis. After clear-felling, it was planted to T. orientalis, most of which has since been cut out for replanting with citrus.

(3) Compartment W.W. The "Westfalia Waterworks" compartment, containing several seepage springs, was formerly under *Pinus patula, which was subsequently replaced with T. orientalis. It was here that W.M. Botha planted some Syzygium cordatum, Rauvolfia caffra and Anthocleista grandiflora, many of which can still be seen together with natural regeneration of these and other hygrophilous trees, e.g. Bridelia micrantha (see p. 45 and ECOLOGICAL NOTES: p. 258).

(4) Compartment 30. This compartment was formerly under *Eucalyptus grandis and then under T. orientalis. Much of it has subsequently been cleared for orchards. The upper Westfalia-Sarahsdrift boundary portions

of the original extent of the Trema plantation are now under avocado orchard.

(B) STRUCTURE AND COMPOSITION

Blank plantings, dead and moribund trees result in a more or less irregularly open tree stratum. Stratification is scarcely developed except for the irregularly discontinuous tree layer and the more continuous field layer although other synusiae are represented as set out below:

(a) Overstory. This synusia consists of a few isolated fair-sized relic trees, particularly of Bridelia micrantha, Combretum erythrophyllum, Euclea crispa and Parinari curatellifolia subsp. mobola, with occasional Celtis africana, Ficus capensis, Pittosporum viridiflorum and Syzygium cordatum (especially in the kloof of Compartment M.F.). In addition, emergent relics and regrowth of wattles (*Acacia spp., particularly *A. mearnsii), *Eucalyptus grandis and *Grevillea robusta occur locally.

(b) Dominant Tree Layer. The "canopy" is open to discontinuously and irregularly closed, especially towards the kloofs, whilst the height varies from about 3 m to over 8 m locally. It is still dominated numerically by T. orientalis of various sizes, often stunted, stag-headed, coppicing after die-back and with many blanks, especially towards the ridges. Probably at least 16 per cent of the original plantings were abortive and at least 10 per cent are moribund. The once almost pure "canopy" is becoming progressively more mixed with the addition of Antidesma venosum, Bridelia micrantha, Dombeya burgessiae and Maesa lanceolata, with occasional Brachylaena transvaalensis, Euclea crispa, Ficus capensis, Parinari curatellifolia subsp. mobola and Rhus intermedia, with isolated Pittosporum viridiflorum and Syzygium cordatum particularly in kloofs.

(c) "Understory" or "Shrub Layer" (about 2 m to 3 m tall). Vernonia ampla is the most abundant species of this stratum, large specimens sometimes forming an understory locally. Other components of this indeterminate class of woody undergrowth are *Cassia laevigata, *Psidium guajava, Diospyros lycioides subsp. sericea, Canthium huillense, Grewia occidentalis and Vangueria infausta, with Annona senegalensis on the lower xeroclines.

(d) Field Layer (up to about 2 m in height). It is convenient in this case to regard the field stratum as comprising three sublayers, as follows:

(i) Low Soft Shrubs, Undershrubs and Tall Subwoody Forbs and Ferns. Besides small specimens of *Vernonia ampla*, the dominant plant in this subclass is clearly *Phaulopsis imbricata*. It is accompanied by the following species:

Pteridium aquilinum	*Stachys grandifolia*
Pseudarthria hookeri	*Tephrosia polystachya*
Pycnostachys urticifolius	*Hibiscus altissimus*
Schistostephium heptalobum	*Sida rhombifolia*
Lippia javanica	*Athrixia phylicoides*
Endostemon obtusifolius	*Eriosema psoraleoides*
Asparagus virgatus	*Helichrysum umbraculigerum*
Helichrysum panduratum	*Leonotis dysophylla*
Indigofera schinzii	*Phyllanthus nummulariaefolius*
Pavonia columella	*Vernonia shirensis*
Tephrosia shiluwanensis	*Cassia mimosoides*
Anthospermum herbaceum	*Helichrysum nudifolium* var.
Nidorella auriculata	*Acalypha petiolaris*
Sida cordifolia	*Aster peglerae*
Rhynchosia komatiensis	*Hermannia floribunda*
Flemingia grahamiana	*Pentas micrantha* subsp. (small kloof,
	Vernonia corymbosa [Compt. 29c)

(ii) Grasses and Grass-like Plants. Considering the Central Hill plantations as a whole, *Setaria chevalieri* is the most abundant grass, being often overwhelmingly predominant, sometimes in almost pure stands to 2 m or more tall, especially down towards the small kloof or gully of Compartment 29c (see Plate 47). The overall subdominant grass is *Hyparrhenia cymbaria* which assumes dominance in the upper more open parts of Compartment 30, where it also occurs in almost pure stands to 2 m or more tall.

Among the more abundant associated grasses and grass-like plants are:

Carex spicato-paniculata	*Bothriochloa glabra*
Cyperus albostriatus	*Brachiaria brizantha*
Hyparrhenia gazensis	*Commelina diffusa*
Setaria sphacelata	*C. eckloniana*
Imperata cylindrica	*Cymbopogon validus*
Panicum maximum	*Digitaria longiflora*
Oplismenus hirtellus	*Mariscus sieberianus*
Paspalum commersonii	*Panicum aequinerve*
Melinis minutiflora var.	*Schoenoxiphium sparteum*
Setaria pallide-fusca	*Sporobolus pyramidalis*
	Rottboellia exaltata (patchy)

The occurrence of some of the above species, e.g. *Imperata cylindrica*, *Setaria pallide-fusca*, *Rottboellia exaltata*, *Commelina diffusa* and

Digitaria longiflora, may be correlated with past and present disturbance.

(iii) Low Herbs and Ferns. This subclass is poorly represented, consisting largely of weedy plants, indicating past and present disturbance. It includes the following among the more abundant species:

Pellaea viridis
Triumfetta rhomboidea
T. pilosa var. effusa
T. pilosa var. tomentosa
Achyranthes aspera
Cyphia elata
Conostomium natalense var.
Zantedeschia tropicalis
Agrimonia odorata
Eulophia streptopetala
Haemanthus magnificus
Hermannia gerrardii
Satureia biflora
Vernonia hirsuta
Abutilon sonneratianum
Conyza persicaefolia
Crinum macowanii
Eriospermum cooperi
Gladiolus sp. (cf. Scheepers 222)
Oxalis semiloba
Senecio sp., aff. S. purpureus

(e) Lianoid Plants. By far the most abundant scandent plant is Smilax kraussiana. Although, in common with Rhoicissus tridentata, Rhynchosia albiflora, Ipomoea wightii and Riocreuxia torulosa, it climbs up into the tree-tops besides clambering about in the undergrowth, most other lianoid plants fall into one or other of the following two synusiae when fully grown:

(i) Lianes and Scramblers. Apart from Smilax kraussiana, the more abundant associated woodier and more robust lianoid plants are Bauhinia galpinii (Compt. 29c), Rhoicissus tridentata, Rubus pinnatus (Compt. 30), Acacia ataxacantha, Clematis brachiata, *Passiflora edulis Mikania cordata, Riocreuxia torulosa, Ipomoea wightii, Rhynchosia albiflora and Adenia gummifera, with occasional Sphedamnocarpus galphimiifolius.

(ii) Softer Slender Climbers. Besides the smaller Smilax kraussiana, Rhoicissus tridentata and Riocreuxia torulosa, the more abundant, less robust lianoid plants include the following:

Rhynchosia caribaea
Abrus fruticulosus
Mucuna coriacea
Stephania abyssinica
Dolichos lablab
Dioscorea cotinifolia
Cissampelos torulosa
Cyphostemma cirrhosum subsp.
Momordica foetida
Adenia digitata
Cayratia gracilis
Ipomoea wightii
Rhynchosia albiflora
Vigna sp.
Glycine javanica
Littonia modesta
Coccinia adoensis
Cyphostemma woodii
Ipomoea obscura var.
Trochomeria hookeri

(f) Epiphytes. Fruticose lichens, e.g. species of Ramalina and Usnea, are locally fairly frequent on the stems as well as the crowns, e.g. in Compartment 30, indicating how the light open crowns of Trema orientalis permit the passage of ample light to the undergrowth, and also, perhaps, the locally reduced vigour of T. orientalis. The only vascular epiphyte seen was a single Polystachya sp., on an emergent Parinari curatellifolia subsp. mobola. This is not surprising as the bark of T. orientalis is probably too smooth to provide a suitable substratum for the establishment of vascular epiphytes.

(g) Parasitic Plants. Cassytha ciliolata is an infrequent slender twining hemi-epiphytic hemiparasite, typically in the more open vegetation of the upper levels of the ridges. It may seriously reduce the vigour of the host, e.g. Trema orientalis, but this is rarely the case.

(C) ECOLOGICAL NOTES

The Central Hill plantations seem to be unstable although the succession is apparently proceeding very slowly in the more unfavourable sites on the more northerly exposed ridges and upper slopes. On the whole, it would appear from the relatively abundant reproduction of such species as Bridelia micrantha, Euclea crispa, Combretum gueinzii, Antidesma venosum, Trema orientalis, Dombeya burgessiae, Rhus intermedia, Acacia ataxacantha and Parinari curatellifolia subsp. mobola, that the succession will proceed almost direct to a subclimax T. orientalis - Bridelia micrantha Associes by a process of thickening up and height increase of the currently transgressive trees. From that stage onwards, the trend would seem to be in the direction of a climax type of scrub-forest association or consociation dominated by Bridelia micrantha with a greater or smaller admixture of other species. In addition to the trees mentioned above, associated species are likely to include Brachylaena transvaalensis, Celtis africana, Combretum erythrophyllum, Ficus capensis, Nuxia congesta, Pittosporum viridiflorum and Syzygium cordatum.

At present, with the exception of Bridelia micrantha, Antidesma venosum and a few relics of Combretum erythrophyllum, typical scrub-forest trees of mature size are infrequent except in the kloofs and on the southerly slopes, where succession is proceeding more rapidly. The more rapid succession in the latter situation is probably at least partly owing to the closer approximation to forest conditions obtaining under the canopy, with Phaulopsis imbricata dominating the field layer, as opposed to the dense growth of Setaria chevalieri and Hyparrhenia cymbaria,

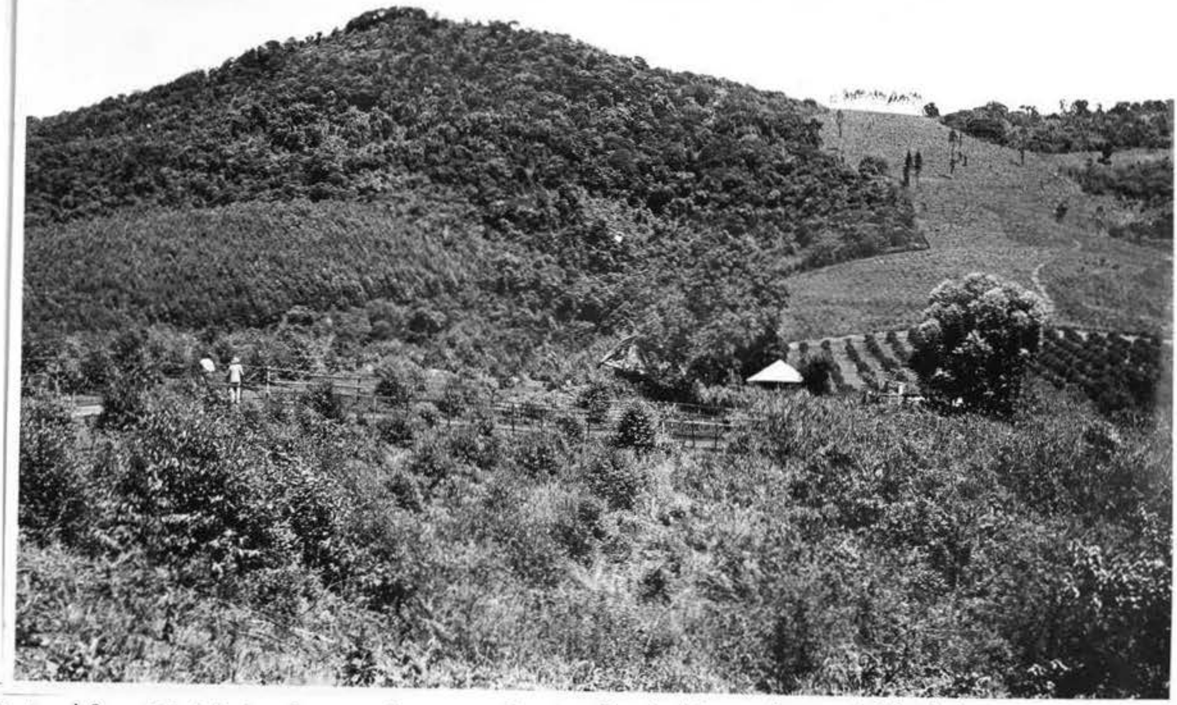

Plate 48. Right background: eucalypt plantation clear-felled in preparation for Trema planting, Christinasrust. Left-centre background: Spitskoppie. (Photo: T.W. Gevers)

Plate 49. Present-day appearance of Christinasrust. Trema plantations in right-centre background. Watershed between Brandboontjies-(right) and Ramadiepa-River catchments in middle distance.

which effectively prevent the rapid intrusion of woody species on the more northerly aspects.

2. THE CHRISTINASRUST TREMA PLANTATIONS

(A) LOCALITY AND HABITAT

The Christinasrust *Trema* plantations lie over the upper catchment of the Brandboontjies River, mostly above the source spring. They are situated on the more or less mesoclinal slopes of the Rakgwale Ridge, a relatively short distance below (more or less southeast of) the Spitskoppie (see Plates 48 & 49).

The sites lie wholly within the Mistbelt, i.e. in the Middle High Forest Zone from about 1250 m to about 1400 m elevation. Gradients are very variable but are usually steep. The upper Brandboontjies catchment is a mostly moderately steep to steep-sided east-facing kloof or narrow valley below, which opens out to a wide and shallow upper portion. There are thus, broadly, four more or less distinct environmental situations, namely:

(1) the exposed central upper portion with a roughly easterly aspect;
(2) the sheltered lower northern portion with a roughly southeasterly aspect;
(3) the sheltered lower southern portion with a roughly northeasterly aspect; and
(4) the exposed upper southern portion with a roughly northeasterly to easterly aspect.

The underlying rocks are various granite-gneisses and gneisses, with schistose rocks, boulders and bedrock becoming more prevalent upwards. Diabase dykes are also present. The soils vary considerably in depth and quality, with parent material, site and degree of disturbance. Some of the soils formerly cultivated by the Bantu croppers are presumably much leached and deteriorated in physical structure. Litter and duff accumulation varies from slight on the lower slopes of the drier northeast-facing ridge (see Plate 50) to ample on the southeast- and upper east-facing slopes.

The sites, previously occupied by old Bantu crop-lands and scrubby vegetation, were planted to eucalypt and pine under previous ownership. These plantations were prematurely clear-felled and replanted with *Trema orientalis*. The impoverished old land "could not have improved much, if at all, under immature plantation crops. In August, 1952, the majority of the *Trema* were stunted and stagheaded." (Keet, 1962). After

TABLE 16. More abundant subordinate trees of *Trema orientalis* plantation, Christinasrust, with notes on their present situation (1962).

Species	Origin	Condition	Distribution
Maesa lanceolata	Self-sown	Thriving	Widespread
Cussonia spicata	Some " most planted	"	" except upper portion
Brachylaena transvaalensis	" "	"	Especially NE aspect
Anthocleista grandiflora	Planted	" but apt to be defoliated by insects	Lower NE aspect
Podocarpus latifolius	"	Struggling	NE aspect. Unsuitable
Harpephyllum caffrum	"	Thriving	NE and SE aspects
Rhus chirindensis forma	Some " probably mostly self-sown	"	Widespread
Rauvolfia caffra	Planted	Struggling except at bottom of kloof	NE aspect
Ficus capensis	Probably mostly planted	Thriving	NE aspect
Heteromorpha trifoliata	Self-sown	"	Widespread
Rapanea melanophloeos	Probably mostly planted	"	Upper NE and E aspects
Prunus africana	Mostly planted but many small seedlings	Transplants struggling; seedlings thriving	Mostly planted NE aspect but seedlings SE aspect
Bridelia micrantha	Planted	Thriving	NE aspect
Euclea crispa	Self-sown	"	Especially NE and E aspects
Allophylus transvaalensis	"	"	Especially SE aspects
Trimeria grandifolia	" very few planted	"	Widespread
Pittosporum viridiflorum	Self-sown	"	Especially the upper E aspects
Halleria lucida	Some planted (probably mostly self-sown)	"	Widespread, especially NE aspects
Ilex mitis	Planted	Sturdy but slow-growing	NE aspect. Very unsuitable site
Kiggelaria africana	Very few planted; " self-sown	" " Healthy	Upper NE aspects
Cryptocarya liebertiana	Planted	Thriving	NE and SE aspects
Maytenus heterophylla	Self-sown	"	Widespread especially Upper NE and E aspects
Nuxia congesta	Planted	"	NE and SE aspects
Scolopia zeyheri	Few planted; very few self-sown	" but probably slow-growing	NE aspect
Syzygium cordatum	Planted	Apparently some failures but several thriving	Kloof bottom and banks of rivulet. Suitable site
S. gerrardii	"	Struggling	NE aspect. Very unsuitable site
Trichilia dregeana	"	Apparently some failures but survivors thriving	Lower NE aspect
Calodendron capense	Few planted	Fair	NE aspect. Unsuitable site
Celtis africana	" "	"	Upper NE aspect
Nuxia floribunda	" "	"	NE aspect

clear-felling, Compartment 12, which included the Brandboontjies source, was contour-trenched before being planted to *T. orientalis*. This compartment was later underplanted (see p. 252). The ensuing discussion will be confined mainly to Compartment 12.

(B) STRUCTURE AND COMPOSITION

A closed canopy is absent over most of the plantations although the *Trema* trees are regularly spaced. *Trema orientalis* trees are thriving at the bottom of the kloof but are mostly rather moribund and frequently dead elsewhere. The underplantings are fairly regularly spaced on the southeastern aspect, becoming more irregular on the northeasterly aspect of the kloof. Underplanted trees are very sparse towards the upper section of the hillside above the kloof, where there is much eucalypt regeneration from stumps and seedlings. In fact, underplanting was mainly confined to the lower-lying northeastern portion of Compartment 12 (Keet, 1962).

Although stratification is much obscured by transgressives and lianoid plants, three or four main strata can commonly be discerned, viz. the first four synusiae discussed below.

(a) Dominant Tree Layer or "Canopy". The dominant tree layer is composed of *Trema orientalis*, from about 3 m to 7 m in height towards the more exposed parts of the ridge, to about 6 m to 10 m tall towards the more sheltered parts of the kloof, becoming taller and better-formed towards the bottom of the kloof. The trees seldom form anything resembling a true closed canopy except where the underplanted trees have reached the general level of the *Trema* trees. On the more exposed upper reaches and on the ridge, short stag-headed and moribund trees become increasingly common (see Plate 50), as in the case of the Central Hill plantations (cf. Plate 46, p.253). At the same time eucalypt regeneration also becomes more striking. In the lower portions of the kloof and on the southeastern aspect, many underplanted trees, especially *Harpephyllum caffrum*, as well as both planted and self-sown *Cussonia spicata*, have reached or pierced the "canopy" of *T. orientalis* (see Plate 51).

(b) Subordinate Trees. The more important subordinate trees are listed in Table 16 in approximate descending order of numerical abundance together with comments on whether they are planted or self-sown, thriving or struggling, and their present distribution. At present, these small trees are mostly transgressives of various sizes. In addition to the species listed in Table 16, an isolated few scramblers

Plate 50. *Trema* plantation, near top of ridge, Compartment 12, Christinasrust, with stag-headed, moribund and dead *T. orientalis*, together with underplanted trees, e.g. *Brachylaena transvaalensis* and *Cussonia spicata*. Note lichen-encrusted stems and branches.

and lianes, viz. Acacia ataxacantha, Cephalanthus natalensis and Dalbergia armata, appear to have been planted, possibly accidentally.

Of the species listed in Table 16, it is noticeable that those species adapted to moister and cooler conditions, e.g. Podocarpus latifolius, Rauvolfia caffra, Ilex mitis, Prunus africana and Syzygium gerrardii, have failed to thrive when planted on the drier warmer northeastern aspects. On the more suitable sites, the same species have responded well. For instance, Rauvolfia caffra has done well when planted in the kloof bottom with readily available ground-water. Although Prunus africana has made poor growth on the northeastern aspect, seedlings of this species are very numerous in the undergrowth of the southeastern aspect.

Differing site quality was not the only difficulty encountered in establishing this community of indigenous trees. Some suitable forest precursors were planted only in small quantities or not at all, apparently because of insufficient viable seed. Rhus chirindensis forma legatii, which is showing marked natural regeneration, does not appear to have been planted at all. Similarly, only a few Nuxia congesta, N. floribunda, Scolopia zeyheri, and very few Apodytes dimidiata, Calodendron capense, Celtis africana, Combretum kraussii, Croton sylvaticus, Fagara davyi, Ficus capensis and Trimeria grandifolia were grown. Other species likely to be suitable such as Allophylus transvaalensis, Aphloia theiformis, Calpurnia aurea, Canthium huillense, Catha edulis, Euclea crispa, Maesa lanceolata and Pittosporum viridiflorum do not appear to have been planted or even sown for the same reasons or because they were overlooked. A lot of seed of Curtisia dentata and a smaller amount of Homalium dentatum seed appear to have been sown but germination of this seed proved unsatisfactory. Some Trichilia dregeana plants were reared in the nursery but they do not all seem to have transplanted successfully to judge by the small number to be seen at present (W.M. Botha, p.c.; S.C. McDonald, p.c.).

(c) Shrub Layer (about 2 m to 3 m in height). Apart from many of the transgressive small trees already mentioned, the shrub stratum is not well represented on the whole. The most abundant shrub or small tree on the northeastern aspect as Canthium huillense. Others among the more frequent shrubby plants are Rhamnus prinoides (especially on the upper east-facing slopes), Canthium inerme, Grewia occidentalis and *Psidium guajava.

(d) Field Layer (up to about 1.5 m in height). The field layer is here more conveniently considered to consist of three sublayers

Plate 51. Trema plantation, Christinasrust, southeast-facing slope: T. orientalis with Harpephyllum caffrum and Heteromorpha trifoliata.

dealt with in turn below. Seedlings and saplings of self-sown and underplanted trees in this stratum have already been discussed generally under the subordinate tree layer.

(i) Low Soft Shrubs, Undershrubs and Tall Subwoody Forbs and Ferns. The most abundant species of this subclass and of the field layer as a whole is *Argyrolobium tomentosum*, especially on the upper eastern and the southeastern aspects. The more numerous associated species are included in the following list.~~with brief notes on their distribution~~.

Stachys grandifolia	*Sparmannia ricinocarpa*
Pavonia columella	*Cineraria fruticetorum*
Hypoestes verticillaris	*Schistostephium heptalobum*
Vernonia ampla	*Flemingia grahamiana*
Pouzolzia parasitica	*Helichrysum odoratissimum*
Pteridium aquilinum	*Phaulopsis imbricata*
Desmodium repandum	*Polygala virgata*
Lippia javanica	*Tephrosia shiluwanensis*
	Helichrysum panduratum

(ii) Grasses and Grass-like Plants. As in the case of the Central Hill plantations, the overall dominant plant of this sublayer is the widespread *Setaria chevalieri*, perhaps more prominent on the upper eastern and northeastern aspects. It is accompanied by *Carex spicato-paniculata*, *Setaria sphacelata*, *Hyparrhenia cymbaria*, *Oplismenus hirtellus*, *Cyperus albostriatus*, *Commelina* sp. (cf. *C. diffusa* ?*C. eckloniana*?) and *Paspalum commersonii*.

(iii) Low Forbs and Ferns. *Galopina circaeoides* dominates this sublayer, particularly on the southeastern and upper eastern aspects. The more abundant associated species include *Triumfetta pilosa* var. *effusa*, *Achyranthes aspera*, *Dietes vegeta*, *Drymaria cordata* subsp. *diandra*, *Crocosmia aurea*, *Lapeirousia grandiflora*, *Pellaea viridis* and *Pteris catoptera*.

(e) Lianoid Plants. Scandent and subscandent plants are fairly conspicuous. Fully grown plants fall into either of two more or less distinct synusiae, as follows:

(i) Lianes and Scramblers. As in the case of the Central Hill *Trema* plantations, species of *Smilax*, *Rubus*, *Mikania* and *Clematis* are conspicuous in the Christinasrust plantations, although *Bauhinia galpinii* is absent. Of the more robust and woody lianoid plants the more abundant types are *Smilax kraussiana*, *Rubus* sp., *R. pinnatus*, Mikania cordata, Clematis brachiata, Choristylis rhamnoides, Rhoicissus rhomboidea, Cyphostemma anatomicum, Rhoicissus tomentosa, Acacia ataxacantha, Adenia gummifera and Canthium gueinzii.

(ii) Softer Slender Climbers. The most numerous scandent plants fall into this synusia, viz. Senecio deltoideus (especially on the upper eastern aspect) and Ipomoea wightii (especially on the northeastern aspect). Associated species include Stephania abyssinica, Dumasia villosa, Cissampelos torulosa, Solanum bifurcum and Cyphostemma cirrhosum subsp. transvaalense.

(f) Epiphytes. Abundant epiphytic lichens, amongst which fruticose forms, e.g. species of Anaptychia, Ramalina, Teloschistes and Usnea, are conspicuous, testify to the location of these Trema plantations in the Mistbelt, and also to the light open crowns and reduced vigour of the trees and the amount of dead wood carried. The possibility that the vigour of the trees can be somewhat reduced by the active growth of lichens, e.g. of species of Usnea acting parasitically (Phillips, 1929), cannot be ruled out entirely.

(g) Parasitic Plants. As in the case of the Central Hill plantations, the slender, twining, hemi-epiphytic hemiparasitic Cassytha ciliolata occurs mainly in the more open vegetation of the more exposed northeastern aspects towards the ridge.

(C) ECOLOGICAL NOTES

Of the small trees and shrubs which have invaded the stand, Canthium huillense is the most important on the more northeasterly aspects, particularly towards the crest of the ridge. Small saplings and seedlings of Prunus africana are abundant in the undergrowth of the lower southeast-facing slopes. Others among the more conspicuous of the species exhibiting abundant invasion and natural regeneration are Maesa lanceolata, Rhus chirindensis forma legatii, Heteromorpha trifoliata, Euclea crispa, Allophylus transvaalensis, Argyrolobium tomentosum, Brachylaena transvaalensis, Choristylis rhamnoides, Cussonia spicata, Trimeria grandifolia, Vernonia ampla, Rhamnus prinoides, Acacia ataxacantha and Halleria lucida.

The indications are that, if undisturbed, those portions of the Trema plantations on the southeastern aspects and in the kloof will be converted to forest within a relatively short time. The development of forest on the upper easterly aspects will take rather longer but it will probably eventually be brought about, provided the aggressive eucalypt coppice growth is effectively controlled. Apart from its active encroachment on the edges of the Trema plantation, the adjacent forest to south and north is likely to continue to play a major rôle as a seed source of invading forest precursors especially of species distributed by birds. Birds spread the seeds of many of the above trees, particularly Maesa lanceolata, Rhus chirindensis forma legatii, Euclea crispa, Allophylus transvaalensis, Choristylis rhamnoides, Cussonia spicata, Trimeria grandifolia, Rhamnus prinoides, Halleria lucida and Pittosporum viridiflorum. The adjacent forest is also likely to be a source of wind-blown seed, e.g. of Brachylaena transvaalensis and Nuxia spp. The succession will probably be much slower on the northeastern aspects, especially towards the ridge, because of the drier, more exposed situation and the space currently occupied by numerous moribund T. orientalis and other stagnating unsuitable underplanted trees.

B. GENERAL REVIEW OF THE TREMA-PLANTING PROJECT WITH PARTICULAR REFERENCE TO HYDROLOGY

In both the Christinasrust and Central Hill Trema plantations, local variations in site quality have been of paramount importance in determining the degree of success achieved in establishing a uniform stand of T. orientalis.

Trema orientalis has not grown well except on the most favourable sites. This is particularly true of the Christinasrust plantations. It is not well adapted to the cooler more humid atmospheric conditions and often leached soils of the Mistbelt where it is only an infrequent pioneer and then usually on xeroclinal and marginal Mistbelt sites. It was not a suitable choice because of its reduced vigour near the limits of its ecological range. This would tend to cause relatively minor deviations from the most favourable conditions obtaining there, to be limiting. It is likely, moreover, that this sensitivity to unfavourable conditions, particularly of soil depth, fertility and moisture, would be enhanced by the severe intraspecific competition induced by planting in pure even-aged stands on marginal sites. It is not surprising that Trema plantations were unsuccessful on the old cultivated soils which had undergone much impoverishment and physical deterioration. Apart from these drawbacks, T. orientalis has proved to be unsuitable for timber plantations owing to practical difficulties of silvicultural management.

It has been contended that no indigenous tree in pure even-aged stands could be used for the amelioration of degraded sites and that the alternatives would then be fallowing old crop-lands, allowing the grassland to revert to scrub (i.e. "bush"-fallowing), and planting to a "long rotation exotic tree crop under systematic management as High Forest" (Keet, 1962). If the latter course is rejected as jeopardising the water resources and the grassland or scrub is not deliberately maintained at an arrested stage of development, then the natural outcome of protection will be eventual conversion to scrub forest and forest. If, as in this case, the establishment of indigenous scrub forest and forest is considered desirable, then this objective could probably be accomplished in less time and with less trouble by planting more suitable and less demanding early-stage pioneer shrubs and trees instead of T. orientalis. Examples of such early-stage colonists are species of Acacia, Calpurnia, Canthium, Catha, Combretum, Euclea, Heteromorpha, Maesa, Maytenus and Rhus, and Hypericum and Myrsine in the High Forest Belt. If large numbers of leguminous forest precursors could be established, these might substantially improve the nitrogen status of the soil once the humus content had built up sufficiently.

After such early-stage shrubs and trees are sufficiently established to provide shelter and to have improved the condition of the soil, later-stage colonists, e.g. Combretum kraussii, Curtisia dentata and Rapanea melanophloeos (in the High Forest Belt), could be established. For continued height growth and timber production, underplanting of the Trema plantations was a good idea in principle, but it met with only limited success owing to the frequent indiscriminate plantings of shade- and moisture-loving forest species on the sunny, drier exposed ridge sites, where they could barely survive at best and do little to improve the infiltration capacity of the soil.

Unsatisfactory growth except under favourable environmental and exacting silvicultural conditions and limited commercial value preclude continued afforestation with Trema orientalis for timber. Timber production was not, however, the main purpose of the project and cannot be the yardstick against which the degree of success or failure is assessed.

The whole question of whether the major aims of the Trema plantations have been realised depends on what the principal objectives were. If the chief end in view was the replacement of the eucalypt and pine plantations by another type of vegetation which would not endanger the water supplies but which would still retain the soil against erosion, then this can, with some reservations, be said to have been achieved. If, on the other hand, the major aim was the conservation and improvement of deteriorated soil through increasing humus and nutrient turnover, by means of afforestation, then the success of the project is less certain. On this criterion, the measure of success of the project is the degree of soil-amelioration which is related to the extent to which successful growth of T. orientalis was achieved. On the whole, the Central Hill plantations were more successful than the Christinasrust plantations. The general question of soil reclamation by afforestation is discussed below (see p.269). The relationship between vegetation and water conservation is still a controversial issue.

Thornthwaite (1948 & 1954), Penman (see Whitmore, 1956) and other workers (see Penman, 1963), have postulated that evapotranspiration is determined by the environment rather than by the nature of the plant communities concerned, provided that water is not in short supply. The rider (water non-limiting) might apply in some South African forestry centres, but neither their provisos nor the formulae derived by these workers would appear to be universally applicable in the northeastern-Transvaal forest areas with their characteristic dry season (see Fig. 4 and Tables 6 - 11, p. 27 et seq.).

In view of the long dry seasons experienced locally, communities of relatively shallow-rooted plants, adapted to undergo a period of dormancy when soil-moisture becomes limiting, are less likely to deplete percolating underground water supplies than deep-rooted evergreen trees like *Eucalyptus grandis which continue to grow and transpire actively as long as ground-water is accessible. Martin and Specht (1962) found that a more mesic *E. obliqua community in South Australia completely exhausted stored soil moisture during periods of low rainfall every year in contrast to the more xeric *E. elaeophora community. These findings led them to consider the possibility that "mesic" communities may possess higher indices of evapotranspiration than more "xeric" neighbouring communities and thus be able to deplete moisture reserves more rapidly. This viewpoint seems to be partially supported by circumstantial evidence in the form of large-scale dying of *E. grandis in plantations during dry years such as have recently been experienced in the Northern Transvaal. It must be remembered that this region has a pronounced dry season towards the end of which, temperatures are high and atmospheric humidity often low (see p. 28-9). Rainfall is, moreover, rather erratic, and hot and dry early summers frequently occur. It is precisely under these conditions that the suggested differences in potential evapotranspiration between different communities are going to be most significant and it is precisely under these conditions that the heaviest demands are made on streams lower downstream.

It does, however, seem likely that any beneficial effects conferred by the Trema plantations on sensitive seepage springs, such as the Brandboontjies River source and some of those arising on the Central Hill, would be reduced or nullified by planting up the valley-bottoms and banks of rivulets with such trees as Anthocleista grandiflora (evergreen), Celtis africana, Combretum kraussii, Rauvolfia caffra and, especially, the evergreen Syzygium cordatum. Syzygium cordatum was planted or left standing in the actual "beds" of the rivulets. In this connection, Pohl (1948) has observed that S. cordatum may have a drying effect on streams. In addition, Rauvolfia caffra and T. orientalis, which are semideciduous on drier sites, tend to be more evergreen where there is sufficient soil moisture, as in the valley-bottoms where their growth and, presumably, their transpiration rates are more rapid. It is not inconceivable that indigenous trees such as Syzygium cordatum, Anthocleista grandiflora, Rauvolfia caffra and Trema orientalis growing along the length of a small rivulet could fully account for the total possible streamflow after a long dry spell and so dry up the rivulet completely. This point of view is supported by the work on the effects on streamflow of the clearing of riparian vegetation by Nänni (Unpubl.), Rowe (1963), Rycroft (1955), and others reviewed by Colman (1953) and Wicht (1949), and the numerous investigations on the influence of evaporation and the transpiration of riparian vegetation on streamflow (e.g. Banks, 1961; Wicht, 1941; see also Wicht, 1941 & 1949 for references).

Even if the environs of the course and source of the upper Brandboontjies River were kept free of the larger evergreen woody plants, the establishment of a forest on the former scrubby glade and crop-land sites might, in the long run, reduce the ground-water discharge of the kloof (cf. Hoover, 1945). On the other hand, keeping the catchment at a grassveld stage of succession by cutting or burning or both, will result in accelerated storm-water discharge and erosion, especially on the steeper slopes, with consequent scouring, silting and flood-damage, erratic streamflow and deterioration in quality of water downstream.

The question of the afforestation-desiccation controversy hinges on whether it is considered more desirable to sustain streamflow or to utilise more of the precipitation where it falls. According to the above argument, the best way to maintain both quality and quantity of the water delivered from such a small source at a reasonable level would seem to be to maintain the vegetation at a low shrubby stage of development by cutting and slashing. Such a compromise would presumably simultaneously limit interception and evapotranspiration and yet cut down on run-off and erosion by preserving and improving the infiltration capacity of the soil. Deep-rooted evergreen trees should thus be discouraged especially near the watercourse and valley-bottom sites and smaller trees and shrubs such as Heteromorpha trifoliata, Hypericum revolutum and Myrsine africana would have to be planted and encouraged instead. Acacia spp., Bridelia micrantha, Celtis africana and other deciduous and semideciduous trees, although often deeply rooted, would probably improve the infiltration capacity of the soil and so earn a reprieve if growing well away from the watercourse. No monetary return would accrue from saw-log timber from such a form of land use, unless some suitable tree species, e.g. Bridelia micrantha , were planted on a sufficiently large scale and allowed to reach timber size.

Trema orientalis was an excellent tree for conservation purposes where it grew sufficiently well to exert an influence on the soil. It has had the added advantage of bearing berries from an early age and so attracting frugivorous birds to the plantations almost from the start. These birds have undoubtedly introduced seed of better-adapted species of shrubs and trees, e.g. Maesa lanceolata and Rhus chirindensis forma legatii, which have contributed to the formation of a more complete cover of vegetation and of litter, towards the betterment of the soil and its infiltration capacity.

The decision as to whether to manage catchments for water production or not, rests with the Trustees of the Hans Merensky Trust. In view of Merensky's express wishes and his views on water conservation in general and on the mountain catchments of the Rakgwale Ridge in particular, it would seem appropriate to endeavour to manage the Christinasrust Trema plantations for the maximum ground storage of water and stabilisation of the upper Brandboontjies streamlet for maximum yield and minimum sediment load. For instance, regular slashing could be considered as an expedient to augment stream-flow especially when there is a shortage of water. On the other hand, although forests may collectively account for much water that could swell streamflow, the cooling effects, in the aggregate, of large total areas of forest and plantation on precipitation over the Escarpment should not be lost sight of and large-scale clearing of existing forest should not be contemplated (see Hursh, 1952; McCulloch & Dagg, 1965; Pereira, 1954).

Apart from the hydrological and purely practical aspects of whether Trema plantations succeeded or failed, the remaining questions of the validity of the theoretical basis of the project and the value of Trema plantations for site amelioration are essentially only facets of the general question of the efficacy of afforestation for soil reclamation, a discussion of which follows.

C. AFFORESTATION AND SOILS

The historical background of the once extensive areas of eroded and leached soil has been sketched (see p. 6 *et seq*. and p. 41 *et seq*.). Some of the worst areas of soil deterioration were those resulting from cropping on the lower portions of the Estate. On the less steep portions of Waterval and Prinsloosrust, long straight furrows were deeply ploughed with little regard to slope. Enormous quantities of topsoil and humus were exposed, eroded and decomposed leaving a practically inert, structureless, leached ferrallitic red clay mineral soil. At a later stage, plantations of **Eucalyptus grandis* were established on a portion of these old lands.

Attempts by Merensky to arrest erosion and improve soil structure by contour-planting robust grasses, e.g. **Pennisetum purpureum* did not meet with much success at first. It was noticed, however, that under the plantations of **E. grandis* the condition of the soil had greatly improved. Eucalypts were accordingly tried as a pioneer soil-binder and cover crop, at which they succeeded in the course of time, even on the most uncompromising soils. After clear-felling and stumping plantations that had been established on abandoned crop-lands some 20 years previously, examination revealed that the condition of the soil had been improved to a considerable depth by litter fall and decomposition, and vigorous root growth. Stands of **Cynodon plectostachyus*, **Pennisetum purpureum* and the "Rakob" strain of *Panicum maximum* grew luxuriantly. These results prompted the chemical investigation of eucalypt litter. Analyses of ash of bark samples revealed relatively high proportions of potassium and, especially, calcium (Read, 1941).

Once the possibilities had been realised, eucalypts were planted on a large scale as part of the soil-reclamation programme except on sites where they might endanger water resources, where *Trema* plantations were established. Unfortunately, no chemical or physical analyses of the exhausted soils were undertaken before or at the time of planting these plantations (J.C. Fick, p.c.).

Apart from the obvious improvement in the physical condition of deteriorated soils, Merensky was convinced that deeply penetrating tree roots take up plant nutrients from the subsoil. These nutrients are eventually gradually released to the topsoil in humus and mineral forms through the breaking down of litter and upper roots by the microflora and fauna of the forest floor in the simultaneously created forest ecoclimate. In terms of this conviction, the considerable depth of the soils was a point strongly in their favour and they could therefore be reclaimed by the establishment of eucalypt plantations. On some of the poorest sites, especially in the low-lying parts, eucalypts made poor growth. In order to speed up humification and mineralisation of organic matter, particularly on such sites, the litter was disced into the soil or "scarified" with a specially constructed disc-harrow. This was said to have had beneficial effects (Lehmann, 1959; J.D.M. Keet, p.c.).

Some of the "pioneer" plantations have since made way for planted pastures, orchards or other crops once the soils had been sufficiently built up. While improvement in physical structure has undoubtedly taken place, there are certain aspects of the use of plantations for soil amelioration that merit closer attention. Very little work has been done in South Africa on the effects of afforestation on soils and practically no reliable widely applicable information is available on long-term effects, especially of eucalypt plantations, on the chemical properties and biology of soils (Von Christen, 1964). Some work on the influence of eucalypts on soils has been undertaken in the winter-rainfall climatic region of Australia but little has been published as yet (Hatch, 1955; Wallace & Hatch, 1952). Eucalypt plantations in Brazil seem to have improved abandoned agricultural land (Homem, Unpubl.) but no particulars based on detailed research appear to be readily available from South America, Africa or other comparable regions.

The widely held convictions on the soil-ameliorating effects of afforestation appear to be borne out by some of the work done in the north temperate zone but only a little experimental work has been done concerning eucalypt afforestation in the Mediterranean climatic region. Comparative investigations of the soils under eucalypts and of adjacent control areas have been carried out in Italy but only short-term observations are available to date. Giulimondi, Funiciello and Arru (1957) found little or no evidence of change in the levels of nitrogen, potassium or phosphorus, although there was a distinct increase in the availability of total exchangeable bases. A contemporaneous investigation of the influence of eucalypts on the microflora and various microbiological processes in the soil revealed that soils under eucalypts seemed to be developing towards an equilibrium differing from that prevailing in the control soils (Florenzano, 1957). Rambelli (1959) partially confirmed Florenzano's results but felt that the eucalypts had tended to deteriorate rather than improve the biological and chemical characteristics of the soil. At a later stage, Rambelli (1963), working on the rhizosphere of *<u>E. grandis</u> (<u>sic</u>) also found a higher percentage of the totality of microbes in the soil near the roots compared with the control soil. The findings of these Italian workers apply to eucalypts growing on sandy soil and under a different rainfall régime, when compared with the conditions prevailing in the Duiwelskloof area. Their results nevertheless suggest that caution must be exercised in establishing the nature of both long-term and short-term changes consequent on afforestation before universally advocating afforestation for soil improvement.

Reviewing the position generally, Ovington (1962) points out that while "there is evidence that woodlands may cause a redistribution of chemical elements within the soil profile, few data are available of changes in the weights of nutrients in the whole soil mass". He adds that "the amounts of exchangeable nutrients and total nitrogen in the mineral soil may be increased in high-producing woodlands having a large uptake". These views are at least partly in agreement with those expressed by Nye and Greenland (1960) in their study of shifting cultivation and "bush" - fallowing with particular reference to the tropics. They marshall much evidence in favour of the view that "over a long period the level of humus and nitrogen in the soil will build up to a limit governed by the type and productivity of the vegetation". They stress that "Though the level of nitrogen may be maintained by long fallows, losses of other nutrients by erosion, leaching and crop removal must be made good from the subsoil; and this will itself be depleted by successive cycles of fallowing and cropping."

Von Christen (Unpubl.) found that the topsoils on Westfalia Estate frequently had higher nutrient contents than the subsoil and that there was often no clear difference between the lower mineral soil and the saprolite in this respect. The fact that the saprolite is frequently just as infertile as the mineral soil renders less important the assertion that eucalypts are able to bring considerable quantities of nutrients to the topsoil from the less-weathered deeper subsoil levels. Von Christen (Unpubl.) suggests that the relatively high return of nutrients to the surface by the eucalypts is probably mainly derived from their immense root systems and the correspondingly large soil volume exploited. He tentatively concluded that eucalypts had influenced "old veld soils" beneficially. Increases in carbon, exchangeable magnesium and calcium appeared to be general but differences in cation exchange capacity, exchangeable potassium, available phosphorus and pH were insignificant or undetected (Von Christen, 1964 & Unpubl.).

The effect of scarifying on the chemical properties of formerly eroded plantation soils was also investigated at Boschhoek. Von Christen (Unpubl.) found that scarification had increased the carbon content of the upper soil by nearly 40 per cent and the level of exchangeable bases by as much as 400 per cent. According to Von Christen (Unpubl.), "Its effect on the quantity and quality of the humus would probably have been even greater if the more deficient minerals had been added by means of fertilizers at the same time."

The rapid and effective restoration of structure and organic matter, including humus, to degraded soil by afforestation with eucalypts is feasible on otherwise suitable sites and will probably be further hastened by scarification and the judicious application of deficient nutrients. The influence of eucalypt stands as pioneer crops consists largely in the increase in organic matter and a continuous improvement of soil fertility seems unlikely unless the organic matter is improved in quality and strictly conserved (Von Christen, Unpubl.).

The effects of afforestation on the physical and chemical properties of soils are likely to vary widely with the species, silviculture and the type of soil concerned (cf. Alway, Kittredge & Methley, 1933; Alway, Methley & Younge, 1933; inter alia). The long-term results of such influences are not necessarily for the better (cf. Gaertner, 1964; McComb & Riecken, 1961; Rennie, 1961; inter alia). Acid leachings of pine mor may increase the already considerable soil acidity and leaching, resulting in other far-reaching and possibly irreversible changes in the availability and exchangeability of nutrients leading, perhaps, to base-desaturation and permanent site degradation (cf. Eyre, 1963; Rennie, 1961; Von Christen, 1964; _q.v._ for further references). Judicious burning of pine litter may be a means of averting these dangers but only a long-term experimental programme will be able to establish whether this is both effective and practicable.

In conclusion, Von Christen (Unpubl.) states that "The ferrallites in South Africa have been used mainly for forestry in the past where their cultivation has not revealed any serious problem so far". He points out that, although they are problem soils in agriculture, they are being increasingly used for agricultural purposes despite the fact that little is known of the plant-soil relationships of this great soil group. Much on-the-spot research needs to be done before long-term effects of afforestation and agriculture, and different silvicultural, horticultural and agricultural treatments, on the deeply weathered and intensively leached ferrallitic soils of this locality can be properly assessed.

Biological soil reclamation can also be expected to have biological consequences. For instance, it has been noticed that there is a marked tendency for _Imperata cylindrica_ to invade eucalypt plantations, especially in the Low Country. This tendency is likely to be accentuated when reclaiming long-abandoned old crop-lands, regularly burned and much-disturbed grassveld where _I. cylindrica_ may have got a good hold. With its deep rootstock, _I. cylindrica_ is one of the few native grasses adapted to survive large-scale active erosion of topsoil. The soil disturbance entailed in establishing a plantation tends to favour _I. cylindrica_ at the expense of other grasses. Where _I. cylindrica_ is abundant, it may seriously inhibit the growth of young eucalypts. In any event, once the plantation has become established, _I. cylindrica_ may well spread and suppress almost all other undergrowth. The danger lies in _I. cylindrica_ being a practically ineradicable weed should such plantation sites be set aside for agricultural or horticultural purposes after soil restoration. Because it is expensive and difficult to control, there are disquieting signs that _I. cylindrica_ is liable to become a serious problem under the systems of land utilisation currently prevailing in parts of the Low Country, viz. orchards and timber plantations.

TABLE 17. Floristic analysis of indigenous species collected on Westfalia Estate.

MAJOR GROUPS	Number of Families	Number of Genera	Number of Species
CYANOPHYTA	1	1	1
LICHENES	8	10	12
HEPATICAE *	4	5	5(+?)
MUSCI	17	30	35
BRYOPHYTA	21	35	40(+?)
LYCOPSIDA	2	2	5
PTEROPSIDA	17	29	51
PTERIDOPHYTA	19	31	56
GYMNOSPERMAE	1	1	2
MONOCOTYLEDONEAE	16	137	267
DICOTYLEDONEAE	96	377	679
ANGIOSPERMAE	112	514	946

* N.B. It must be remembered that the Jungermanniales were not collected at all although numerous species of these hepatics are present.

CHAPTER IX

FLORISTICS

A. FLORISTIC ANALYSIS AND DISCUSSION

The results of a floristic analysis of the appended check-list are summarised in Table 17. Of a total of 1122 of all species collected, the total number of indigenous plants collected amounts to 1057 species, distributed amongst 592 genera and 162 families. Of the indigenous plants, vascular plants comprise 132 families, 546 genera and 1004 species. The spermatophyte flora consists of 113 families, 515 genera and 948 species. The size distribution of locally represented angiosperm families is discussed below, taking the number of native species as the criterion of the size of a family.

The Compositae is the largest family, with 38 genera and 109 species indigenous, assuming all species of *Gnaphalium*, *Inula*, *Siegesbeckia* and *Spilanthes* to be indigenous. Next in order comes the Gramineae with 56 genera and 106 species indigenous (assuming certain weedy species to be so, viz. *Digitaria adscendens*, *D. debilis*, *D. longiflora*, *D. ternata* and *D. zeyheri*, *Setaria verticillata*, *Eleusine africana*, *Eragrostis arenicola* and *Eragrostis ciliaris*). The indigenous Leguminosae are represented by 38 genera and 91 species. If one considers the Leguminosae to be an order of three families, then four genera comprising eight species belong to the Mimosaceae, five genera comprising nine species to the Caesalpiniaceae and 29 genera comprising 74 species to the Papilionaceae. On the assumption that *Cyperus rotundus* is probably introduced but that *C. papyrus* subsp. *nyassicus* occurs naturally, the 14 genera of the Cyperaceae have 47 species between them.

The Liliaceae (*sens. lat.*) consists of 40 species distributed amongst 22 genera. Regarding *Richardia* as exotic but *Borreria* as indigenous, the family Rubiaceae includes 22 genera comprising 36 species. Assuming all five species of *Asclepias* recorded to be indigenous and certain sterile material to be correctly identified as species of *Xysmalobium* and *Tylophora*, the Asclepiadaceae totals 18 genera comprising 34 species. The 18 genera of the Orchidaceae are represented by 31 species if one ignores *Aerangis* sp., cf. *A. kotschyana*, based on poor material. The relative preponderance of all the angiosperm families represented is set out in Table 18.

The largest genera include the following: *Helichrysum* (24 or 25 species and one variety); *Senecio* (17 spp.); *Cyperus* (15 spp.); *Vernonia* (14 spp.); *Indigofera* (12 spp.); *Eragrostis* and *Rhynchosia* (10 spp.

TABLE 18. Relative preponderance of angiosperm families of the indigenous flora of Westfalia Estate and immediate environs as represented in the Check-list (see Appendix B)

Family	No. of Genera	No. of Species	Percentage	Family	No. of Genera	No. of Species	Percentage	Family
Compositae	38	109	11.52	Caryophyllaceae	(3 or) 4	(4 or) 5	0.53/(0.42)	Achariaceae
Gramineae	56	106	11.21	Geraniaceae	2	4	0.42	Annonaceae
Leguminosae	38	91	9.62	Myrtaceae	2	4	0.42	Aquifoliaceae
Cyperaceae	14	47	4.97	Polygalaceae	1	4	0.42	Araceae
Liliaceae	22	40	4.23	Proteaceae	2	4	0.42	Balanophoraceae
Rubiaceae	22	36	3.81	Rhamnaceae	4	4	0.42	Begoniaceae
Asclepiadaceae	18	34	3.59	Thymelaeaceae	4	4	0.42	Chenopodiaceae
Orchidaceae	18	31	3.28	Dioscoreaceae	1	3	0.32	Connaraceae
Labiatae	16	29 (or 30?)	3.07	Ebenaceae	2	3	0.32	Cornaceae
Euphorbiaceae	16	27	2.85	Gentianaceae	2	3	0.32	Cruciferae
Acanthaceae	11	19	2.01	Guttiferae	1	3	0.32	Dipsacaceae
Scrophulariaceae	14	19	2.01	Juncaceae	1	3	0.32	Droseraceae
Malvaceae	55	17	1.80	Lauraceae	3	3	0.32	Ericaceae
Iridaceae	8	14	1.48	Meliaceae	2	3	0.32	Eriocaulaceae
Campanulaceae	4	13	1.37	Myrsinaceae	3	3	0.32	Gesneriaceae
Convolvulaceae	5	12	1.27	Oxalidaceae	1	3	0.32	Hamamelidaceae
Umbelliferae	8	10	1.06	Passifloraceae	2	3	0.32	Heteropyxidaceae
Anacardiaceae	5	9	0.95	Piperaceae	2	3	0.32	Hippocrateaceae
Flacourtiaceae	8	8	0.85	Santalaceae	2	3	0.32	Loranthaceae
Rosaceae	7	8	0.85	Sapindaceae	3	3	0.32	Malphigiaceae
Solanaceae	1	8	0.85	Araliaceae	1	2	0.21	Monimiaceae
Tiliaceae	4	8	0.85	Balsaminaceae	1	2	0.21	Myricaceae
Vitaceae	3	8	0.85	Capparidaceae	2	2	0.21	Nymphaeaceae
Cucurbitaceae	6	(7 or) 8	0.85/(0.74)	Halorrhagidaceae	2	2	0.21	Phytolaccaceae
Amaryllidaceae	5	7	0.74	Icacinaceae	2	2	0.21	Pittosporaceae
Celastraceae	3	7	0.74	Lentibulariaceae	1	2	0.21	Potamogetonaceae
Commelinaceae	4	7	0.74	Melastomataceae	2	2	0.21	Primulaceae
Crassulaceae	2	7	0.74	Melianthaceae	2	2	0.21	Rhizophoraceae
Polygonaceae	3	7	0.74	Menispermaceae	2	2	0.21	Salicaceae
Rutaceae	6	7	0.74	Musaceae	2	2	0.21	Sapotaceae
Amaranthaceae	5	6	0.63	Ochnaceae	2	2	0.21	Saxifragaceae
Combretaceae	2	6	0.63	Oleaceae	2	2	0.21	Turneraceae
Loganiaceae	4	6	0.63	Onagraceae	2	2	0.21	Typhaceae
Moraceae	1	6?	0.63?	Pedaliaceae	2	2	0.21	Valerianaceae
Sterculiaceae	3	6	0.63	Ulmaceae	2	2	0.21	Velloziaceae
Urticaceae	5	6	0.63	Violaceae	2	2	0.21	
Apocynaceae	4	5	0.53	Xyridaceae	2	2	0.21	
Boraginaceae	4	5	0.53					
Ranunculaceae	4	5	0.53	Achariaceae	1	1	0.11	
Verbenaceae	4	5	0.53					

This and other families represented by one species each are listed in the right-hand column each); Plectranthus (nine spp.); Digitaria (probably some eight or nine species indigenous); Panicum, Hibiscus, Ipomoea and Solanum (eight species each); Hyparrhenia (seven species and one variety); Setaria, Pycreus, Asparagus, Eulophia (one species includes two varieties), Ficus, Crotalaria (some are possibly relatively recent introductions), Acalypha and Conyza with six species each; and Andropogon, Gladiolus, Polygonum (with a variety), Crassula, Acacia, Tephrosia, Sida, Combretum, Asclepias, Oldenlandia and Lobelia (five species each).

An adequate account of the affinities of the flora of Westfalia Estate would be lengthy but of little value. It would be to better purpose to discuss the affinities of, say, the Northeastern-Transvaal Escarpment flora because the Westfalia Estate is not sufficiently representative of the larger area. Several of the most interesting floristic links and outliers of this region have not been collected on Westfalia Estate. For this reason, the present account will be limited to a brief résumé of some of the floristic affinities revealed by some of the plants recorded from the Estate. Leaving the widely distributed mosses and ferns out of account, the majority of spermatophytes are also found in Tropical Africa. Judging by some available accounts and check-lists of collections in Central Africa (Bally, 1946; Brenan & collaborators, 1953 & 1954; Chapman, 1962; Dale, 1940; Goodier & Phipps, 1961; Kerfoot, 1964; Pitt-Schenkel, 1938; Rendle et al., 1911; Snowden, 1933) some 493 species, i.e. about 52 per cent of the Angiosperms on Westfalia Estate are shared with Central Africa, particularly the uplands and highlands of East Africa. The real figure is likely to be very much higher if the relationship is more closely investigated.

There appear to be two mainstreams of Tropical African elements present. One is the somewhat impoverished and attenuated southward extension of the East African Montane Forest Formation, more typical of the higher elevations, and the other is the southerly extension of the East African Savanna Woodland Formation. Representatives of the former stream include such characteristic species as Anthospermum ammanioides, Aphloia theiformis, Cryptocarya liebertiana, Cuscuta kilimanjari, Ensete ventricosum, Hypericum revolutum, Ocotea viridis, Plectranthus swynnertonii, Prunus africana, Rhynchosia clivorum, Suregada procera and Viola abyssinica. Elements of the latter formation are (or were formerly) also prominent constituents of the flora of the lower altitudes, e.g. Adina microcephala, Albizia versicolor, Annona senegalensis, Bauhinia galpinii, B. kirkii, Cassia petersiana, Combretum suluense, Dichrostachys cinerea subsp. nyassana, Ehretia amoena, Ficus petersii, F. sycomorus, Jumellea filicornoides, Piliostigma thonningii, Pterocarpus angolensis, Pterolobium exosum, Sclerocarya birrea, Secamone parvifolia, Steganotaenia araliacea and Terminalia sericea.

Some species do not belong exclusively to one or other stream but occur indiscriminately throughout. Such adaptable species tend to be widespread in Central and Southern Africa, e.g. Loudetia simplex. Other species, not confined to one or other stream, tend to be less frequent in the High Forest and Savanna Woodland Belts and more characteristic of the intervening Scrub Forest Belt of the foothills. Of these species, typical widespread Tropical African elements are, for instance, Anthocleista grandiflora, Bridelia micrantha, Parinari curatellifolia (subsp. mobola) and Syzygium cordatum.

The lower elevations show a close affinity with the Lowveld to the east, with which a great many of the East African Savanna Woodland elements are shared. All told, some 398 species, i.e. about 42 per cent of the Westfalia flora, are common to the flora of the Estate and the Kruger National Park flora as listed by Van der Schijff (Unpubl.).

The affinities of the Westfalia Estate flora seem to lie more with the East African Montane and Savanna Woodland floras to the north and east than with the South African High-Mountain and Southern floras to the south and southwest. Only 218 species, i.e. about 23 per cent of those listed (Killick, 1963) for the Cathedral Peak area, also occur in the vicinity of Westfalia Estate. Elements of the Cape flora are rare in this vicinity, to judge by the paucity of species known from the Cape Peninsula as enumerated by Adamson, Salter and co-workers (1950). Only some 87, i.e. about 9 per cent of the species of the flora under consideration also occur indigenously in the Cape Peninsula. Only 11, i.e. 3.9 per cent, of the characteristically "Cape" genera listed by Weimarck (1941: p. 90-97) are recorded from Westfalia Estate and vicinity, where they typically play a relatively subordinate part in the vegetation, viz. Ehrharta, Ficinia, Schoenoxiphium, Watsonia, Moraea, Disa, Protea, Cliffortia, Erica, Stoebe and Ostoespermum. Moreover, several of the species common to this area and the Cape are widely distributed afro-montane elements (cf. Weimarck, 1941: p. 124 et seq.). Notable amongst these are, for instance, the widespread Thalictrum rhynchocarpum, the eastern Cardamine africana and the southern Leucosidea sericea.

Some of the montane forest elements are widely distributed from the Central African mountains to the Cape, e.g. Curtisia dentata and Prunus africana, while other apparently southern elements extend far to the north on the same mountains, e.g. Alepidea gracilis var. major, Aristea ecklonii, Cliffortia nitidula var. pilosa, Leidesia procumbens, Leucosidea sericea and Stoebe vulgaris. Some East African montane elements do not range much farther south than the Northeastern or sometimes Eastern Transvaal and Swaziland, e.g. Anthospermum ammanioides, Aphloia theiformis, Cryptocarya liebertiana, Cuscuta kilimanjari, Ensete ventricosum and

Ocotea viridis. This also applies to several less typically montane Tropical African elements, like Anthocleista grandiflora and Vernonia ampla, and a few species more characteristic of the Scrub Forest Zones, like Hibiscus altissimus. There are also many Central African savanna woodland elements that do not extend farther south than the Northern and Eastern Transvaal, Swaziland or Zululand. These include Adina microcephala (var. galpinii), Albizia versicolor, Bauhinia galpinii, Cyrtorchis praetermissa, Ehretia amoena, Eragrostis arenicola, Ficus sycomorus, Piliostigma thonningii, Pterocarpus angolensis, Pterolobium exosum, Steganotaenia araliacea, Vernonia colorata and several others, some of which are mentioned below.

Even from this superficial account, it is evident that the Tropical African affinities of the region under consideration are strong. This is particularly true of the Savanna Woodland and Scrub Forest Belts. The Montane High Forest Belt also shows a great floristic affinity with the East African Montane Forest Formation, while elements of the "Southern" or Cape flora are only sparingly represented.

B. NEW AND INTERESTING RECORDS FROM WESTFALIA ESTATE

The following is a concise account of some of the more intriguing plant records noted from Westfalia Estate. The distributions are only briefly sketched and have mostly been ascertained from the specimens lodged at the National Herbarium, Pretoria. Unless otherwise stated, the numbers cited are the author's collecting numbers.

Scheepers 1222 is apparently the first South African record of the moss Erythrodontium abruptum.

Angiosperms include several grasses and sedges of interest. However, no actual first records for South Africa were noted among the grasses. Scheepers 630 is the first collection of Eragrostis arenicola from South Africa since 1930, when it was first recorded from Palmaryville in the Soutpansberg district. The first South African record of Melinis tenuissima is from the Tzaneen area in 1914. It was not registered again until collected on Zomerkomst, near Politsi, by the present author, who has also noted it to occur on Westfalia Estate. Schlechter collected Schizachyrium brevifolium from Houtbosch in 1894. It was not recorded again until collected on Westfalia. This grass may be fairly common in disturbed places, where it sometimes occurs in almost pure stands in extensive patches. Its small size may account for its being overlooked for so long. Except as a weed in a hothouse (Lowes 534 Nelspruit), Setaria homonyma was only known to occur in South Africa from the Soutpansberg (Koker 9) until collected on Westfalia. In South-West Africa, de Winter and Marais collected it in the Okavango area.

Cyperus papyrus subsp. nyassicus has been discussed on p. 35. A gravelly sandy miniature floodplain near the Merensky Dam is the first recorded locality for Mariscus firmipes in South Africa (Podlech, 1961). Another interesting record is that of a mesophytic tropical form of the sedge Bulbostylis boeckeleriana. This form was not previously recorded from South Africa.

Among the orchids, material of Habenaria sp. (915) could not be matched. The epiphytic Polystachya sp., aff. P. zambesiaca appears to be undescribed (Schelpe, 1962). Gatherings 411 and 784 are apparently the first South African records of Polystachya imbricata subsp. imbricata, previously known from Tropical Africa. Two other epiphytes collected on Westfalia Estate, viz. Jumellea filicornoides (157) and Oberonia disticha (899), represent new generic records for South Africa.

In the National Herbarium, Pretoria, Pilea worsdellii was only represented by the gathering of Schlechter from Houtbosch, 1894, until this Urticaceous species was collected at Westfalia Estate (590).

Among the Hamamelidaceae, Trichocladus ellipticus (783) is a new record for the Transvaal, which serves to link the southerly distribution centre of this species with the distribution records from East Africa. Killick & Marais 2065 from Umtata was formerly the most northerly occurrence recorded from South Africa.

It has, as yet, not been possible to name or match Rubus sp. (750). This material may possibly represent a new taxon foreign to South Africa or it may prove to be a spontaneous hybrid.

Two unidentified species of Vigna have been collected on the Estate. One (143) grows quite freely in the undergrowth of a eucalypt plantation, apparently matching a specimen from the Modjadji Location, but the other (unnumbered specimen) was only once collected by the author, on a small termitarium in a railway firebreak, i.e. a much-disturbed site.

The first South African gathering of Suregada procera appears to be that of W.M. Botha at De Hoek Government Forest Reserve (near Tzaneen). Its true identity was not realised until it and Scheepers 782 were recently authentically identified.

Peucedanum venosum seems to have been collected first by Junod from Spelonken. Junod 1361 from Masetane (near Shiluvane in the present-day Letaba District) represents the type specimen of this species, described by Burtt Davy (1932). As far as the National Herbarium at Pretoria is concerned, this species remained unnamed for many years. Other subsequent collections of this species appear to have been Breyer TM 22101 (from Louis Trichardt) and J.D. Krige 14 (from Modjadji's Reserve). Peucedanum venosum was discovered anew when Junod TM 20282 (from Spelonken) and Scheepers 368 were recently matched at Kew.

Another interesting record appears to be that of Strychnos mitis. On Westfalia Estate it has only been seen as a rare understory tree in a Drypetes gerrardii Consocies (see p. 119-22).

Scheepers 1134 represents the third South African record of Exacum quinquenervium, previously only known from South Africa by the gatherings of Junod 16109 (Shiluvane) and Van der Schijff 2865 (Nwatindlopfupan, Kruger National Park).

Flowering material of Mondia whitei from the Transvaal was first collected (1058) on Westfalia Estate. Sterile material collected by Gerstner (5805) from Magoebaskloof apparently belongs to this species.

Cuscuta kilimanjari extends from Tropical Africa into the Northeastern Transvaal, where four gatherings have been made to date, viz. Ethel M. Doidge (unnumbered specimen, Woodbush), Junod 4445 (Selati Poort), Taylor 658 (Woodbush) and Scheepers 647 (Westfalia Estate).

The only South African gatherings of Hyptis spicigera at the National Herbarium, Pretoria, are Junod TM 10215 (Shiluvane) and Scheepers & Joynt SKF 1677 (Westfalia Estate).

Another first record for South Africa is that of Oldenlandia goreënsis (709).

The identity of the South African material of Pentas micrantha subsp. wyliei has recently been confirmed. Before Scheepers 1078 was collected on Westfalia Estate, this species was represented at the National Herbarium, Pretoria, by specimens collected by Wylie (sub Wood 7590 & 8480) from Ngoye, dating from the turn of the century.

Another early record from Westfalia Estate is an unnumbered specimen of Oreosyçe subsericea. Earlier gatherings (with dates) at the National Herbarium, Pretoria, are: Junod (59) TM 25414 Spelonken (1918); Moss 14537 Louis Trichardt (1927); Blenheim & Young s.n. Louis Trichardt (1927).

Scheepers 869 is one of the first records of Inula paniculata from South Africa. Previous South African gatherings were made by Young from the Middelburg (Transvaal) District and by Bruce & Kies from the Pietersburg District.

Most, if not all, of the species mentioned in the above account are more widely distributed in Central Africa. This can be taken as further substantiating the assertion that the flora of Westfalia Estate is strongly Tropical African in affinity.

CHAPTER X

SUMMARY AND CONCLUSIONS

The early settlement of Westfalia Estate and vicinity was characterised by inappropriate land use and improvident exploitation of the natural resources resulting in loss and deterioration, in both quality and quantity, of water, soil and vegetation.

After Merensky purchased Westfalia Estate, large-scale conservation and reclamation work was undertaken to counteract the results of the foregoing malpractices. Provision was made for the continuance of this work after his death.

Land use must be related to the three broad topographical and ecological belts, viz. the Montane or High Forest Belt, the Foothill or Scrub Forest Belt and the Lowland or Savanna Woodland Belt, which have suffered different degrees of timber-cutting, clearing, burning, grazing and cropping in the past. These differing habitats and histories demand somewhat different reclamation, conservation and utilisation practices.

Apart from the impact of man, climate, as determined by topography plays the decisive rôle in the ecosystem. Topography is, in turn, largely determined by the underlying geological structure of the area.

The geology of the area is uniform, bedrock consisting mainly of Archaean granite-gneiss enclosing scattered schistose xenoliths of the Primitive Systems. These ancient rocks are dissected by numerous diabase dykes trending mostly in a northerly to northeasterly direction. This trend combined with the southwesterly-northeasterly direction of strike of the foliation planes of schistose rocks and of the banding of gneissose rocks has led to a general southwest-northeast trend of spurs and valleys as a result of differential weathering and erosion along these lines of weakness.

The Rakgwale Ridge, containing the longest stretch of schistose xenoliths, is a continuation of the Woodbush (Houtbosch) spur complex of the Great Escarpment and forms the northwestern rim of a large embayment enclosing an area of relatively high rainfall and normally warm frost-free climate.

Under these conditions, the parent rocks are usually deeply weathered and have given rise to soils that are, on the whole, very uniform, viz. predominantly ferrallitic red clays and clay loams. These soils are normally very much weathered and leached and organic matter plays an indispensable part in the nutrient cycle.

The prevailing southwest-northeast orientation of spurs results in striking disparities in environment between the northwestern and southeastern slopes at comparable elevations. The different aspects combined with differences in altitude and associated factors like soil depth and rainfall give rise to a great diversity of habitats and plant communities.

The habitats are grouped into two broad climatic belts, viz. the Mistbelt and the Low Country, which are, in turn, subdivided into climatic zones according to Papadakis' climatological classification. The Low Country includes the Dry, the Moist/Dry and the Moist Monsoon Subtropical Tierra Fria climatic zones. The Mistbelt includes the Humid Medium Tierra Fria and the Humid Cool Tierra Templada climates which cannot be correlated with the vegetation zones at present, owing to inadequate climatological definition.

Biotic factors are relatively unimportant at present, except for multifarious far-reaching human influences. The latter consist largely of the disturbance attendant on burning, cutting and grazing of vegetation, cultivation and establishment of crop-lands, orchards and timber plantations and the restoration of stability following the application of various conservation measures. These influences have given rise to a variety of plagioseral and secondary communities, several examples of which are dealt with in Appendix A, and artificial communities, e.g. Trema plantations. Frugivorous birds have played an important part in the furthering of succession, especially in accelerating the secondary succession implicit in bush-fallowing and in the Trema plantations.

The plant communities are grouped into three broad vegetation belts based on the physiognomy of the climax vegetation, viz. the Savanna Woodland Belt, the Scrub Forest Belt and the High Forest Belt. These belts are subdivided into vegetation zones. On Westfalia Estate, the Savanna Woodland Belt is represented by the Lowveld Sour Bushveld Transition Zone (i.e. transitional to the typical savanna woodland of the Lowveld plains). It is characterised by the prominence of certain deciduous and semideciduous trees, e.g. species of Pterocarpus and Combretaceae such as Combretum suluense and Terminalia sericea. The Scrub Forest Belt consists of the Low Scrub Forest Zone and the High Scrub Forest Zone, falling into the Low Country and Mistbelt climatic belts respectively. A heterogeneous assemblage of deciduous, semideciduous and evergreen trees, such as species of Antidesma, Bridelia, Parinari, Euclea and Nuxia, typifies the Scrub Forest Belt. The High Forest Belt is subdivided into the Lower, Middle and Upper High Forest Zones. The High Forest Belt is characterised by such tall evergreen montane-forest trees as Cryptocarya liebertiana, Trichilia dregeana, and Syzygium gerrardii. Although the Upper High Forest Zone is not represented on Westfalia Estate but only borders parts of the Estate, it is superficially discussed for the sake of continuity.

The Marginal Mistbelt communities of the Rakgwale Ridge, characterised by steep environmental gradients, are also briefly dealt with.

The present status of plantations of Trema orientalis was also investigated. An assessment of the success or failure of this venture is attempted. Trema plantations were successful as a means of conserving and improving exposed, eroding and exhausted soils by speeding up the normal bush-fallowing process, especially in the Low Country where T. orientalis grew more vigorously. It is largely owing to the introduction of the seeds of woody plants by birds, attracted by the crops of small fruits borne by T. orientalis from an early age, that bush-fallowing was accelerated. In the Mistbelt Trema plantations, this process was further assisted by artificially underplanting indigenous trees but, as with T. orientalis, these trees did not succeed on unsuitable sites. On the whole, the process of reconditioning degraded soils could have been executed more efficiently if several appropriate species had been more discriminately planted with reference to the diverse local habitat factors prevailing on each site. A prerequisite for the success of a project of this nature would be a sound understanding of the different courses of succession in different situations and a knowledge of optimum and normal ecological amplitudes, habits, growth rates and tolerances of the species likely to be useful. An alternative course of action that can be considered for the improvement of impoverished sites is the establishment of eucalypt plantations.

While it can be argued that a plantation of deciduous trees will probably transpire less during the dry season than a plantation of rapidly growing evergreen trees with well-developed root systems like eucalypts, this supposition cannot be accepted as experimentally proven. The assumption that a high forest or a mature plantation of largely evergreen indigenous forest trees will use less water than a comparable eucalypt plantation, other things being equal, is more doubtful. While plantations of Trema orientalis or other deciduous woody plants may be quite useful for soil reclamation and endanger water resources less than eucalypt plantations, the latter are clearly more productive, more lucrative, more tolerant of poor sites and apparently more suitable for reconditioning impoverished soils where vulnerable water resources are not a prime consideration.

The value of eucalypt plantations for soil reclamation depends on their tolerance of poor soils, their well-developed root systems, their rapid growth and their protection of the floor. Except on extremely poor and marginal sites, this leads to a rapid accumulation of organic matter, an improvement in the physical structure of the soil, increased nutrient turnover and a concentration of nutrients in the surface litter, duff and topsoil. Eucalypt plantations are thus able to build up topsoil and organic matter layers which may previously have been shallow or absent. The long-term effects of eucalypt litter on the chemical and biological properties of soils are not certainly known. Only a comprehensive long-term research programme will reveal the long-term effects on different soils of afforestation with eucalypts. There is a strong possibility that the afforestation of poor sites with pines will result in mor formation and soil deterioration. Judicious burning of pine litter may be a method of averting these dangers but only long-term experimental work can show this.

Cultivation of short-term crops is inadvisable on the leached ferrallitic soils where the nutrients are largely concentrated in the organic matter on and in the topsoil. The clean cultivation of perennial crops like pine-apples is also detrimental. The prevailing forms of land utilisation in the area, viz. timber plantations and citrus, avocado, litchi and pecan-nut orchards, are well adjusted to the necessity for preserving a stable and protected soil surface. The actual forms of land use are largely determined by economics as affected by factors like soil depth and quality, presence and quantity of water available for irrigation, slope, exposure and accessibility. On sites considered unsuitable for the growing of timber or citrus, avocado or other orchards, consideration could be given to the growing of plantation crops like coffee and tea. As the demand for water increases, the management of the Montane Belt for water production is likely to merit more and more serious consideration. This would require a solid foundation of empirical and experimental evidence. Such a scientific basis could only be obtained by basic research into the correlations existing between streamflow and the vegetation in catchments.

The flora is rich with distinct Tropical African affinities. The Savanna Woodland flora has strong East African Savanna Woodland affinities, as demonstrated by the presence of *Pterocarpus angolensis*, and *Ficus sycomorus*. Southern and East African Montane elements characterise the Montane or High Forest Belt, e.g. *Curtisia dentata*, *Leucosidea sericea*, *Prunus africana*, *Aphloia theiformis*, *Cryptocarya liebertiana*, *Ensete ventricosum* and *Ocotea viridis*. The Scrub Forest vegetation of the foothills is a heterogeneous assemblage of both mainstreams together with certain typical foothill elements; e.g. *Anthocleista grandiflora*.

Little natural vegetation remains on private property in the Lowveld Sour Bushveld Transition Zone, the Scrub Forest Belt and the Lower and Middle High Forest Zones. Apart from State-owned Forest Reserves, Westfalia Estate probably carries the greatest area of relatively unscathed vegetation in the Duiwelskloof-Tzaneen region. In view of the scarcity of natural vegetation in this region, serious consideration could be given to the protection of selected representative areas of natural and seminatural vegetation in a relatively good state of preservation as nature reserves for the conservation of the flora and fauna for posterity. These areas are naturally mainly confined to rocky land, gullied land and kloofs, steep slopes, riparian sites, swamps and "kommetjies", i.e. areas in which the vegetation is of great importance in controlling run-off, storm-water discharge and erosion. In view of possible far-reaching hydrological effects attending such disturbance, the draining of swamps and the cultivation and afforestation of steep slopes, kloofs and the vicinity of "kommetjies", riparian sites and swampy bottom lands should be viewed with the utmost caution.

From observations of numerous secondary communities (described in Appendix A), it is evident that the indigenous vegetation is aggressive. Secondary succession to more natural communities is rapidly set in motion if the secondary communities are protected from further disturbance, as in the instance of the Madikeleni Catchment.

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PART 2: APPENDICES

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APPENDIX A

SECONDARY COMMUNITIES

As mentioned previously, discussion of secondary succession is, with few exceptions (p. 75-7, 208-12, 239 & 251-64), confined to the Appendices. The various subseral stages are dealt with in their respective vegetation zones in the order in which the latter are treated in the text, except that the secondary communities of the Marginal Mistbelt are described between those of the Low Country and the Mistbelt. In the following discussion, the subseres of the Lowveld Sour Bushveld Transition Zone are taken as representative of secondary succession in the Low Country. Mistbelt subseres are here represented by subseres of the Montane or High-Forest Belt. As previously mentioned (p. 123), subseres of the Low Scrub Forest Zone resemble those of the Lowveld Sour Bushveld Transition Zone, as do the earlier stages of the High Scrub Forest Zone. Later subseral stages of the High Scrub Forest Zone approximate those of the Lower High Forest Zone more and more closely as succession progresses.

As before, the names of exotic species are preceded by an asterisk. Where it is not altogether certain that the species concerned is exotic, the asterisk is followed by a question mark, e.g. * ? *Trichodesma zeylanicum*.

1. LOW COUNTRY

THE LOWVELD SOUR BUSHVELD TRANSITION ZONE

Two subseres have been distinguished in the Lowveld Sour Bushveld Transition Zone. The first is the typical secondary succession on the usually clayey red ferrallitic soils. This sere is essentially similar throughout the Low Country and even the lower Mistbelt vegetation zones. Secondly, there is a subsere of a more specialised type referred to as the "Secondary Psammosere" (see p. 5-8, Appendix A).

(A) "OLD-LAND" SUCCESSION ON RED FERRALLITIC SOILS

The following description is based on notes made from 1958 to 1960 on two lands formerly under eucalypt plantation and subsequently clear-felled, burned and made available for maize cultivation. The one maize field was still in use in 1958 and has since been put under citrus. The other field was lying fallow in 1958 and has subsequently been partially planted up with pasture grasses.

No clear-cut pioneer stages could be recognised. It must be stressed that the vegetation is very aggressive. Succession usually proceeds rapidly except where soils are so extremely leached that succession remains arrested at the weed stage for a prolonged period. The classic sequence of annuals, perennial herbs and woody plants does not apply except as a general tendency with many exceptions. Woody plants enter the sere at an early stage or even from the start depending upon the proximity of seed sources.

(1) Early Stages. Bare ground is usually first colonised by annual weeds of which *Bidens pilosa is the most abundant species. Oxalis semiloba frequently forms extensive stands owing to vegetative propagation resulting from fragmentation caused by cultivation. This species is thus a relic of former conditions. Acalypha ciliata, *Erigeron floribundus, *Ageratum conyzoides and Triumfetta annua may also be locally common weeds. Other examples of the more common short-lived pioneer forbs are the following:

Corchorus tridens	*Amaranthus hybridus
C. trilocularis	Cassia occidentalis
Crassocephalum crepidioides	Ceratotheca triloba
Commelina africana	*Chenopodium album
C. benghalensis	*C. ambrosioides
C. diffusa	*C. murale
Euphorbia hirta	Conyza aegyptiaca
Phyllanthus burchellii	C. persicaefolia
Siegesbeckia orientalis	C. pinnata
Sida rhombifolia	Erlangea laxa
Sonchus oleraceus	Hibiscus cannabinus
Hibiscus meeusei	Malvastrum coromandelianum
Leucas martinicensis	Sida cordifolia
Triumfetta rhomboidea	S. pseudocordifolia
T. pilosa var. tomentosa	*Tagetes minuta
Acalypha segetalis	*?Trichodesma zeylanicum
Crotalaria mucronata	*?Gnaphalium luteo-album
*Oxalis corniculata	G. purpureum
*Physalis peruviana	Pavonia columella
*Salvia coccinea	*Richardia brasiliensis
Nidorella resedifolia	Vernonia fastigiata
	Waltheria indica
	*Xanthium strumarium

The above weeds of cultivation are the first pioneers together with or soon followed by ruderal grasses and sedges. Some of the first pioneer grasses are annuals but they also include perennials, which are small at first if cultivation was thorough. Typical pioneer grasses and sedges are Chloris pycnothrix, Cynodon dactylon, Cyperus esculentus, Digitaria adscendens, D. longiflora, D. ternata, D. zeyheri, Eleusine africana, Eragrostis aspera, E. curvula, Kyllinga cylindrica, Mariscus sieberianus, Panicum glabrescens, Rhynchelytrum repens, Rottboellia exaltata, Sporobolus pyramidalis and Urochloa mosambicensis.

Accompanying the grasses is the hemiparasitic or parasitic* Striga asiatica as a relic of the former maize crops. Crossandra greenstockii, Cyperus albostriatus, Hypoxis angustifolia, H. rooperi, Pellaea viridis, Pteridium aquilinum, Smilax kraussiana and Zantedeschia tropicalis, among others, may be present as persistent relics of former conditions. More woody perennials maintain or establish themselves from coppice growth as well as from seed. These include Diospyros lycioides subsp. sericea, Rhoicissus tridentata, Acacia spp., Rubus pinnatus, Combretum gueinzii, Euclea crispa, Ficus capensis, *Psidium guajava, Ziziphus mucronata, Adenia digitata, *Cassia laevigata, *Cedrela toona, *Doxantha unguis-cati (plantation relics), Trema orientalis and Vernonia ampla.

(2) Fallow Stage. This stage is characterised by large-scale increase and spread of perennials, which contribute substantially towards the formation of a more stable plant cover. These perennials include many grasses and sedges, e.g. Eleusine africana, Eragrostis curvula, Kyllinga cylindrica, Mariscus sieberianus, Panicum maximum, Cyperus esculentus, Hyparrhenia dissoluta, Paspalum commersonii, *P. urvillei, Rhynchelytrum repens and Sporobolus pyramidalis, with occasional Cyperus albostriatus and *Paspalum dilatatum.

Many forbs, creepers and shrubs also invade and contribute towards the formation of a more stable vegetation cover, more particularly the following:

Acalypha petiolaris
Achyranthes aspera
Borreria scabra
Cassia mimosoides
Conostomium natalense var.
Crotalaria lanceolata
Ipomoea plebeia subsp.
Oldenlandia affinis
Eriosema psoraleoides
Gnaphalium undulatum
Lippia javanica
*Oenothera indecora
Pavonia columella
Solanum panduraeforme
Wormskioldia longepedunculata
Abutilon sonneratianum
*Acanthospermum brasilum
Agrimonia odorata (moister spots)
Artemisia afra
Cassia petersiana
Convolvulus farinosus
Cucumis sp.
Helichrysum panduratum
H. nudifolium var.
*Ipomoea purpurea
Laggera alata
Mucuna coriacea
*Nicandra physaloides
Nidorella auriculata (especially moister spots)
Ocimum urticifolium
*Physalis peruviana
Pseudarthria hookeri
Pycnostachys urticifolia
Rhynchosia hirsuta
Senecio sp., aff. S. purpureus
S. pterophorus
S. sceleratus
Tephrosia polystachya
T. shiluwanensis
Vernonia ampla
V. schirensis
Zornia capensis

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* see Rogers & Nelson, 1962.

In addition to the above more widespread species, some ruderal forbs seem to be more or less restricted to the Lowveld Sour Bushveld Transition Zone, viz. **Capsicum frutescens*, *Celosia trigyna*, *Hibiscus physaloides*, *Ipomoea arachnosperma*, *Kohautia lasiocarpa*, *Laggera pterodonta*, *Panicum novemnerve*, **Physalis angulata* and *Vernonia cinerea*.

The foregoing species tend to become suppressed by the invasion and increase in size and number of tufted grasses especially *Hyparrhenia dissoluta*, *H. filipendula* vars., *H. gazensis*, *H. hirta*, *H. rufa*, *Cymbopogon validus*, *Eragrostis curvula* and *Sporobolus pyramidalis*. Associated grasses are *Andropogon amplectens*, *A. schirensis* var. *angustifolia*, *Bothriochloa glabra*, *Brachiaria brizantha*, *Hyparrhenia cymbaria*, *H. glauca*, *Schizachyrium semiberbe*, *Setaria sphacelata*, *S. chevalieri* and *Trachypogon spicatus*. *Imperata cylindrica* may also become locally abundant in patches.

Contemporaneously with the formation of a more stable and dense plant cover, there is a tendency for more shrubs and trees to become established. This results in the formation of a scrubby grassveld dominated by the grasses just mentioned together with some or all of the following trees and shrubs, depending on the proximity of seed sources, the past history and the persistence of coppice growth:

Acacia ataxacantha
A. davyi
A. karroo
Antidesma venosum
Bauhinia galpinii
Bridelia micrantha
Combretum gueinzii
Dombeya rotundifolia
Euclea crispa
Faurea saligna
F. speciosa
Ficus capensis
Maytenus heterophylla
Parinari curatellifolia subsp.
**Psidium guajava*
Pterocarpus rotundifolius
Rubus pinnatus
Trema orientalis
Vernonia ampla
Ziziphus mucronata
Dombeya burgessiae (few)
Peltophorum africanum (few)
Pterocarpus angolensis (few)

Common subseral scrub constituents are the shrubby or suffrutescent *Diospyros lycioides* subsp. *sericea*, *Lippia javanica*, *Pseudarthria hookeri*, *Rhynchosia komatiensis* and *Vernonia shirensis*, with the creeping and scrambling *Smilax kraussiana*, *Rubus pinnatus* and *Mucuna coriacea*, with *Cassytha ciliolata* (hemiparasitic) and, frequently, *Asparagus africanus*. *Helichrysum nudifolium* var. *quinquenerve* may be more or less abundant, accompanied by *Aspilia africana*, *Dipcadi viride*, *Gerbera glandulosa*, *G. jamesonii*, *Inula glomerata* and other forbs associated with the grasses in the field layer.

As the scrub closes and a canopy tends to form, such grasses as *Eragrostis curvula* and *Sporobolus pyramidalis* tend to be shaded out and replaced by other monocotyledonous herbs, such as *Asparagus virgatus*, *Carex spicato-paniculata*, *Paspalum commersonii* and *Setaria chevalieri*, while *Smilax kraussiana* and *Acacia ataxacantha*, in particular, render

(B) SECONDARY PSAMMOSERE

An irregular patchwork of various stages of this sere may be observed on the gravelly sandy soil of the miniature flood plain of the Motshunguludzi River on the Fredericksdal side near where the river enters Merensky Dam. This site was made available to the Bantu for the cultivation of crops for some 10 years from 1946 (see p. 9). Not only is the soil leached to a considerable but variable degree, but the degree of disturbance also varies greatly from scarcely disturbed fallows to sites where large quantities of sand have recently been removed. The successional relationships are inferred from the differing vegetation of differentially disturbed sites.

The water table is in places within reach of the more deeply rooted plants, at least by capillarity. For the typically shallow-rooted plants, however, the coarse sandy substratum is subject to extreme and prolonged desiccation which is a controlling factor inhibiting the establishment of all seedlings in this habitat. Another limiting factor is occasional intense heat, sufficient to be injurious at the soil surface, while yet more infrequent ground frosts may also limit the successful establishment of some species in this river-valley site (cf. p. 26 & p. 61-2).

As a result of the inaccessibility or accessibility for plant growth of the water table, the vegetation varies from extremely xeroseral to almost hydroseral in parts. The margin of the riverside boundary of the secondary psammosere merges with the outer margin of the Combretum erythrophyllum Consocies (see p. 64-6). These facts are alluded to in sundry references to the moister situations, although the succession is typically xerarch.

(1) Early Stages. Among the most important first pioneers of the newly exposed bare sand are Fimbristylis hispidula, Perotis patens, Cyperus amabilis, Kohautia omahekensis, Rhynchelytrum repens and *Richardia brasiliensis, with occasional Andropogon eucomus and Sesamum alatum.

Where the sandpits are sufficiently deep for the water table to be at or sufficiently near the surface for water to be almost constantly available owing to capillarity, hygrophilous grasses and sedges are also amongst the most important pioneers of bare sand. Digitaria debilis and Panicum glabrescens may be found both in standing water or away from water with Andropogon eucomus, Cyperus distans, Lipocarpha senegalensis and even Scirpus inclinatus.

(2) Later Stages. The composition of the earlier stages following after the first pioneers is strongly influenced by the nature, time and

duration of the disturbance. Grasses and sedges continue to play a major rôle. Cynodon dactylon predominates on the most disturbed sites, especially along roadsides and paths. Others of the more abundant species are the following:

Fimbristylis hispidula	Mariscus sieberianus
Digitaria longiflora	Monsonia biflora
Eleusine africana	Panicum glabrescens
Digitaria zeyheri	P. natalense
Perotis patens	Sesamum alatum
*Richardia brasiliensis	*Acanthospermum brasilum
Zornia capensis	Brachiaria brizantha
Cyperus esculentus	Cassia absus
Eragrostis gummiflua	Cleome monophylla
Cyperus amabilis	Crotalaria lanceolata
Mariscus firmipes	Gnaphalium undulatum
Pogonarthria squarrosa	Hibiscus cannabinus
Rhynchelytrum repens	H. meeusei
Sporobolus pyramidalis	Hyparrhenia hirta
Kohautia omahekensis	*Lepidium virginicum
Agathisanthemum bojeri	Microchloa caffra
Ceratotheca triloba	Polycarpaea corymbosa
Eragrostis arenicola	Sporobolus fimbriatus var.
E. ciliaris	S. stapfianus
E. curvula	Stereochlaena cameronii
E. curvula forma (cf. Scheepers 637)	Stylosanthes mucronata
Hyparrhenia dissoluta	Wahlenbergia banksiana

Among the adventive species noted and collected on the disturbed sand have been Dicoma macrocephala and Helichrysum zeyheri.

The abundance of many of the above species, more especially the annuals, at any time is strongly influenced by the time of the year and the favourableness of the current and preceding seasons for germination and seedling growth. These variable seasonal effects tend to mask the seasonal aspect dominance of this and the following stages, where the conspicuousness of certain vernal and aestival aspect plants is more strongly influenced by the advent of rainy weather than by day length or temperature, e.g. Dipcadi viride.

The next stage in the sere greatly resembles the preceding one in species composition but the relative importance of the various species differs. As in the previous stage, grasses and sedges play an important part. Rhynchelytrum repens is here the dominant grass, accompanied by the following more abundant species:

Fimbristylis hispidula
Cynodon dactylon
Pogonarthria squarrosa
Sporobolus fimbriatus var.
Zornia capensis
Digitaria longiflora
Eragrostis curvula
Eriosema psoraleoides
Perotis patens
Stereochlaena cameronii
Kohautia omahekensis
Senecio sp., aff. S. purpureus
Sporobolus pyramidalis
Andropogon eucomus
*Erigeron floribundus
*Lepidium virginicum
Agathisanthemum bojeri
Artemisia afra
Cassia mimosoides
Crassocephalum crepidioides
Dipcadi viride

Eleusine africana
Hibiscus meeusei
Hyparrhenia dissoluta
Mariscus firmipes
Microchloa caffra
Nemesia capensis
Nidorella auriculata
Panicum natalense
Phragmites communis
*Richardia brasiliensis
Triumfetta rhomboidea
Urochloa panicoides (disturbed sites)
Wahlenbergia banksiana
Waltheria indica
Agrimonia odorata
Cassia absus
Eragrostis curvula forma (cf. Scheepers 637)
Gnaphalium undulatum
Hibiscus cannabinus
*Oenothera indecora
Sporobolus pyramidalis
Helichrysum kraussii

Less recently disturbed areas support a dense stand of *Erigeron floribundus, Eriosema psoraleoides, Senecio sp., aff. S. purpureus, Nidorella auriculata and *Verbena bonariensis, with occasional Pseudarthria hookeri. *Verbena bonariensis stands and local aggregations of Phragmites communis, with Agrimonia odorata, Imperata cylindrica, Lippia javanica, Rubus pinnatus and even the more hygrophilous Rubus sp. (cf. Scheepers 750) and Cliffortia nitidula var. pilosa, with sometimes extensive patches of Hemarthria altissima and luxuriant Paspalum commersonii, suggest that underground water is locally available for such plants as are able to make use of it. If the water table is in places as near to the surface as apparently attested to by the presence of hygrophilous plants, this may well be an artificial condition consequent on the raising of the water level of the nearby Motshunguludzi River, after the damming of the Ramadiepa River.

Towards the outer edge of the Combretum erythrophyllum Consocies (see p. 64-6), the rank and weedy grassveld with Eriosema psoraleoides, Phragmites communis and others yields to a transition zone which is evidently encroaching on the grassveld in places. The most conspicuous plants of this ecotone are soft or low shrubby or lianoid plants. The more abundant plants of the ecotone are set out below, grouped into life-form classes.

(a) Small Trees, Tall Soft or Low Woody Shrubs. This class is dominated by Leonotis dysophylla accompanied by Eriosema psoraleoides, Lippia javanica, transgressive Acacia karroo and Combretum erythrophyllum, Diospyros lycioides subsp. sericea, Vernonia ampla, transgressive Acacia ataxacantha and Rubus sp. (cf. Scheepers 750), with occasional *Psidium guajava and Rhamnus prinoides.

(b) Lianoid Plants. The predominant lianoid plant is Mucuna coriacea, accompanied by Rubus pinnatus, Rhynchosia caribaea, *Passiflora edulis, Rumex sagittatus, Smilax kraussiana and Stephania abyssinica.

(c) Soft or Subwoody Suffrutices, Herbs and Ferns. This class can be conveniently subdivided and dealt with as follows:

(i) Soft or Subwoody Suffrutices and Forbs. Dominating this subclass as well as the whole marginal zone is Senecio sp., aff. S. purpureus, accompanied by other tall or subwoody herbaceous weeds of the previous stage. Associated species are Artemisia afra, *Erigeron floribundus, Agrimonia odorata, Triumfetta rhomboidea, Anthospermum herbaceum, Helichrysum nudifolium var. quinquenerve, H. panduratum, Hypoestes sp.?(H. aristata?), Ceratotheca triloba, Endostemon obtusifolius and Indigofera arrecta.

(ii) Grasses. These are of relatively infrequent occurrence. Among the most frequently encountered species are Setaria chevalieri, Sporobolus fimbriatus, Hyparrhenia filipendula and H. hirta (scattered), and Imperata cylindrica (in patches, gregarious).

(iii) Ferns. Pellaea viridis and Pteridium aquilinum occur rather infrequently and gregariously.

(C) PLAGIOSERES

Except for artificially planted stands, plagioseral communities are of limited distribution in the Low Country being confined mainly to firebreaks alongside the railway line, plantations and roadsides, and other regularly disturbed areas. The firebreaks are annually slashed or burned or both and long stretches of the railway firebreak are regularly cultivated by Bantu railway-workers and their families, who grow maize, ground-nuts, "matabala" (Coleus rotundifolius) and other crops in the railway reserve. These disturbed sites carry much-retarded secondary communities, providing the last remaining habitats in the Lowveld Sour Bushveld Transition Zone and the Low Scrub Forest Zone for relics of the formerly widespread grassveld and savanna vegetation. The following list includes some of the more typical species of these "plagioclimaxes", which are characterised by vernal and aestival aspect-society forbs:

Acalypha punctata
Adenia digitata
Aeschynomene nyassana
Albuca sp., cf. A. fastigiata
A. setosa (= A. pachychlamys)
Alloteropsis semialata (Low-Country form)
Aloe greatheadii
A. lettyae
Andropogon amplectens
A. schirensis var.
Anthericum galpinii
A. transvaalense
Argyrolobium transvaalense
Aristida congesta subsp.
Arthrosolen microcephala
Asparagus africanus
Aspilia africana
Becium knyanum
Callilepis salicifolius
Cassia mimosoides
Cenchrus ciliaris
Chaetacanthus setiger
Clerodendron triphyllum
Clutia monticola
Commelina africana
C. benghalensis
Conostomium natalense var.
Conyza aegyptiaca
Corchorus tridens
C. trilocularis
Crassocephalum crepidioides
Crossandra greenstockii
Cyperus compactus
Cyphostemma woodii
Dicoma zeyheri
Digitaria diagonalis
D. milanjiana
Diospyros lycioides subsp.
Dipcadi viride
Drimia alta
Eragrostis capensis
E. curvula
E. superba
Eriosema burkei
E. cordatum var.
E. psoraleoides
Eriospermum cooperi
Eulophia clavicornis var. clavicornis
E. clavicornis var. inaequalis
E. odontoglossa
E. parviflora
E. streptopetala
Eupatorium africanum
Euphorbia trichadenia
Fadogia monticola
Galopina aspera
Gazania krebsiana subsp.
Gerbera glandulosa
G. jamesonii
Gladiolus psittacinus sens.lat.
G. woodii
Haemanthus magnificus
Helichrysum latifolium
H. nudifolium var.
Heteropogon contortus
Hyparrhenia dissoluta
Hyparrhenia gazensis
H. rufa
Hypericum aethiopicum subsp.
Hypoxis rigidula
H. rooperi
Imperata cylindrica
Indigofera hilaris
I. sanguinea
Ipomoea crassipes
Justicia anagalloides
J. cheiranthifolia
Kohautia omahekensis
Kyllinga cylindrica
Lannea edulis
Lasiosiphon caffer
Lotononis eriantha
Moraea sp., aff. M. trita
Mucuna coriacea
Myosotis afropalustris
Nidorella resedifolia
Oxalis depressa
Panicum maximum
Paspalum commersonii
Pearsonia atherstonei
Pelargonium luridum
Pentanisia angustifolia
Perotis patens
Polygala albida
P. amatymbica
Raphionacme hirsuta
Rhynchelytrum repens
Rhynchosia monophylla
R. nervosa
R. totta
Scabiosa columbaria
Schizachyrium brevifolium
Schizoglossum cordifolium
Scilla sp., cf. S. ovatifolia
Senecio erubescens
S. sceleratus
Silene capensis
Sporobolus pyramidalis
Striga asiatica
S. bilabiata
Tephrosia macropoda
T. tzaneenensis
Themeda triandra
Thesium costatum
Thunbergia atriplicifolia
Trachyandra saltii var.
Tragia rupestris
Tragus berteronianus
Triumfetta welwitschii var.
Tryphostemma viride
Urginea multisetosa
Urochloa mosambicensis
Vernonia hirsuta (Low-Country form)
V. natalensis
V. oligocephala
Wahlenbergia banksiana
W. undulata
W. virgata
Waltheria indica
Wormskioldia longepedunculata
Zantedeschia tropicalis
Zornia capensis

Plate 52. View northeastwards along Rakgwale Ridge, from boundary firebreak of Christinasrust below (northeast of) Spitskoppie. Note contrasting vegetation of Kranskop xerocline with *Acacia davyi* and *Faurea speciosa* (left), and Christinasrust mesocline with portion of *Cussonia spicata* - Other Species Associes forest margin in centre. Mokeetsi- or Koedoes-River Valley in distance beyond.

2. MARGINAL MISTBELT

(A) PLAGIOSERES

On the more or less northeastern slopes of Spitskoppie, along the northern boundary firebreak of Christinasrust, is to be found much-disturbed grassveld (see Plate 52). This disturbed grassveld can be regarded as plagioseral (or plagioclimax) resulting from the annual slashing and burning of the firebreak. Some grazing and browsing by livestock may also occur at times.

The habitat here is intermediate between that of the xeroclines (see p. 240-1) and that of the mesoclines (see p. 241-50). The soil may be locally fairly deep although the ground is rocky with outcrops of schistose rocks and diabase.

Within the actual firebreak, the most luxuriant and the most abundant plants seem to be grasses and grass-like plants, notably Eragrostis curvula, Hyparrhenia hirta, Rhynchelytrum repens, Setaria sphacelata, Themeda triandra, Commelina diffusa, Hyparrhenia gazensis and Sporobolus pyramidalis, with scattered H. cymbaria and Panicum maximum. These are accompanied by numerous forbs, shrubs and ferns, particularly the following:

Acalypha punctata
*Acanthospermum brasilum
Cyphia elata
Indigofera sanguinea
I. schinzii
Flemingia grahamiana
Pseudarthria hookeri
Pteridium aquilinum
Rhynchosia komatiensis
Mohria caffrorum
Pellaea viridis
Rhoicissus tridentata
Argyrolobium transvaalense
*Bidens pilosa
Cynoglossum sp., cf. C. lanceolatum?
Hypoestes aristata
Pelargonium luridum
Peucedanum caffrum
Rhynchosia caribaea
*Tagetes minuta
Thunbergia atriplicifolia
Triumfetta pilosa var. effusa
T. rhomboidea
Vernonia ampla
V. corymbosa
V. hirsuta
V. shirensis
Wahlenbergia banksiana
Aspilia africana
Cyphia transvaalensis
Dioscorea dregeana var.
Inula glomerata
Leonotis dysophylla
Nidorella auriculata
Pavonia columella
Plectranthus calycinus
Agrimonia odorata
Conostomium natalense var.
Galopina aspera
Helichrysum nudifolium var.
H. umbraculigerum
Polygala virgata
Schistostephium heptalobum
Smilax kraussiana
Tephrosia polystachya
Wahlenbergia madagascariensis

Farther west, along the boundary, on the more level parts of the crest of the ridge on to Weltevreden-Roedevlakte, the soil tends to be even more exposed to sun and wind. The plagioseral vegetation changes somewhat in character, becoming less luxuriant in growth. West of

Spitskoppie several species tend to disappear, e.g. Argyrolobium transvaalense and Peucedanum caffrum, while other species, e.g. Helichrysum nudifolium var. quinquenerve, tend to increase, together with the addition of the following species:

Aster peglerae
Chaetacanthus setiger
Crossandra greenstockii
Cycnium adonense
Cymbopogon validus
Eupatorium africanum
Fimbristylis hispidula
Helichrysum acutatum
Hypericum aethiopicum subsp.
Hypoxis angustifolia
Knowltonia transvaalensis
Kyllinga cylindrica
Mariscus sieberianus
Pentanisia prunelloides
Senecio erubescens formae
S. orbicularis
S. sceleratus
Tephrosia macropoda
Tragia rupestris
Vernonia sp., aff. V. monocephala
Wahlenbergia virgata
Bulbostylis burchellii
B. collina
B. oritrephes
Cineraria fruticetorum
Disa patula var.
Eucomis undulata
Ficinia sp., cf. F. stolonifera
F. filiformis
Harveya speciosa
Hebenstreitia comosa
Helichrysum setosum
Lobelia erinus
Lysimachia ruhmeriana
Pelargonium multicaule
Salvia aurita
Satyrium neglectum
Senecio fibrosus
S. panduratus
Silene capensis
Striga bilabiata
Trichodesma physaloides
Zantedeschia tropicalis

Here and there, small trees of the adjacent less-disturbed areas, are found in the firebreak, e.g. Acacia davyi, Curtisia dentata, Greyia radlkoferi, Pittosporum viridiflorum and Rhus intermedia. On the less-disturbed xeroclinal slopes, the trees are more common and include, more especially, Acacia davyi and Faurea speciosa, with Ficus capensis, but F. capensis suffers a great deal from fires sweeping up from the north (see Plate 52). Also present are the Lowveld form of Vangueria infausta and Cussonia natalensis, revealing the affinities of the xeroclinal vegetation of the ridge not only with the Lowveld to the north and east but also with the vegetation of the edge of the Pietersburg Plateau to the north and west. In the less-disturbed grassveld south of the fire-break, now planted up with pines, Lobelia graciliflora formerly occurred, revealing the affinity of the Marginal-Mistbelt and Montane Belt transition zone of the ridge with the main Escarpment to the west. In general, as can be seen in the species lists, the Marginal-Mistbelt plagioseral communities are intermediate in species composition between secondary communities of similar origin in the Low Country (cf. p. 8 & 9, Appendix A) and in the Mistbelt (cf. p. 18 & 19, p. 34 and p. 45-6, Appendix A).

(B) SUBSERES

(1) Marginal Mistbelt Scrub: Canthium huillense Consocies and Canthium huillense-Other Species Associes. Scrub communities dominated by Canthium huillense are a common feature of succession in the Mistbelt (p. 15, 22-4, and 28 & 29, Appendix A). The marginal communities discussed here are developed just south of the northern boundary firebreak of Weltevreden on the Rakgwale Ridge. They are probably best regarded as secondary owing to a considerable measure of disturbance in the past.

(1.1) Habitat. Marginal-Mistbelt Canthium huillense - dominated scrub communities are found along and just to the north of the top of the ridge at an altitude of about 1350 m to 1375 m. The aspect varies from a negligible to a slight northerly to northwesterly slope. These sites are fully exposed to wind from all quarters, including mist- and moisture-bearing southerly to easterly winds and desiccating warm to hot, dry northeasterly to northwesterly winds. The long drought periods are, however, apparently not much alleviated by fog-drip.

The soils do not appear to be very humiferous, with only slight accumulations of litter and duff. They are mostly shallow to very shallow and often stony. The parent material consists mostly of schistose amphibolitic and serpentinitic rocks, and perhaps talc-schist.

Although Bantu livestock may have grazed and browsed here more frequently in the past, they seldom do so nowadays and then with little appreciable effect. Grazing and browsing by game is probably very light, particularly in view of the poaching that continues to take place. Occasional troops of baboons forage along the ridge, apparently also with negligible effects. It appears likely that fires formerly swept up both sides of the ridge probably especially from the north. Since the recent bulldozing of a firebreak to the north and the establishment of pine plantation to the south, the site seems to have been protected from fire. Although fires probably once occurred frequently, the occurrence of fire is not in itself considered to be an unnatural factor. In this instance, at any rate, frequent fires are not considered sufficiently abnormal to justify the separation of these subseral stages as significantly different from priseral stages of comparable status.

(1.2) Structure and Composition. A "canopy" is practically non-existent, the upper layer being low and uneven, irregularly open to closed. The trees are irregularly spaced except for Canthium huillense, which sometimes occurs in dense, more or less evenly spaced and even-aged pure stands, especially in the Canthium huillense Consocies. There is little other evidence of stratification although the species present do fall naturally into different synusiae as dealt with below:

(a) Tree Layer. The tree "stratum" (3m to 5 m in height) is discontinuous and many of the trees are immature. The trees are mostly rather scattered except where the scrub merges into scrub forest and forest (p. 244-50). The most abundant trees appear to be *Acacia davyi* with larger specimens of *Canthium huillense* sometimes gregarious but *C. huillense* usually grows as a shrub under 3 m in height. Other small trees include *Calpurnia aurea*, fair-sized *Cussonia spicata* and *Maytenus heterophylla*, with occasional *Apodytes dimidiata*, *Brachylaena transvaalensis*, *Curtisia dentata*, *Dombeya burgessiae*, *Euclea crispa*, *Maesa lanceolata* and *Pittosporum viridiflorum*, with scattered *Maerua cafra* amongst others.

(b) Shrub Layer. The small tree or shrub *Canthium huillense* predominates in the shrub stratum (2 m to 3 m tall), often growing gregariously in dense socies with *Lippia javanica* subdominant, accompanied by variable sized *Vernonia ampla*, with *Grewia occidentalis* and rather small *Maytenus mossambicensis* var. *mossambicensis* with *Vernonia corymbosa*.

Also present in the shrub stratum are numerous transgressive trees notably *Heteromorpha trifoliata* and *Pittosporum viridiflorum*. These small trees are accompanied by *Maytenus heterophylla* with *Acacia davyi*, *Calpurnia aurea*, *Clausena anisata*, *Allophylus transvaalensis*, *Apodytes dimidiata* and *Rhus chirindensis* forma *legatii*, with occasional *Scolopia zeyheri*.

(c) Field Layer. Herbs, especially grasses, up to about 2 m tall, may be locally common to almost absent in places. Noteworthy are *Cymbopogon validus* and *Polygala virgata*, accompanied by *Asparagus virgatus*, *Hyparrhenia cymbaria*, *Phaulopsis imbricata*, *Hypoestes aristata*, *Schistostephium heptalobum*, *Argyrolobium tomentosum*, *Conostomium natalense* var. *glabrum*, *Flemingia grahamiana*, *Hebenstreitia comosa*, *Hyparrhenia hirta*, *Senecio pandurifolius* and *Thunbergia natalensis*, with occasional *Aloe lettyae*, *Pseudarthria hookeri* and *Setaria chevalieri*. In addition to the woody species mentioned under the two previous synusiae, this stratum includes transgressive *Carissa bispinosa* var. *acuminata* and occasional *Trimeria grandifolia*.

(d) Lianoid Plants. The most abundant liane is *Clematis brachiata*. It is accompanied by *Smilax kraussiana*, with occasional *Asparagus falcatus*, *Rubus pinnatus*, *Secamone gerrardii* and *Sphedamnocarpus galphimiifolius*. Softer slender twiners include *Ipomoea wightii*, Rhynchosia caribaea, Stephania abyssinica, Dolichos lablab and Riocreuxia picta, with occasional Cissampelos torulosa and Senecio deltoideus.

(e) Epiphytes. The only epiphytes noted were a few scattered colonies of Polystachya ottoniana on isolated fair-sized Cussonia spicata and other trees fully exposed to the wind and mist.

(1.3) Ecological Notes. As noted elsewhere (see p. 231; p.15 & 22, Appendix A), Canthium huillense frequently tends to grow gregariously in sometimes extensive almost pure stands. Such a C. huillense Consocies would appear to represent a relatively early stage of succession. Owing to the dense growth and severe competition, this consocies may be only slowly colonised by other species to develop eventually into a Canthium huillense - Other Species Associes. The stand described above seems to be an indiscriminate mixture of different developmental phases too complicated to be worthwhile describing separately. The C. huillense - Other Species Associes will, it seems, develop by way of a Marginal-Mistbelt scrub forest into a low scrubby Marginal-Mistbelt high forest similar to the Cussonia spicata - Other Species Association described in Part I (p. 244-50).

3. MISTBELT

3.1 THE LOWER HIGH FOREST ZONE

In the following account, two main classes of subseres are distinguished thus:

(A) Subseres developed on old cultivated land

(B) Subseres developed on "plagioclimax" sites, i.e. sites of past disturbance, i.e. burning, cutting and grazing, after cessation of the disturbance.

(A) "OLD-LAND" SUCCESSION

Although there is no shortage of abandoned crop-lands in this zone, these represent only the earlier subseral stages for the most part and no complete account of secondary succession can be given. However, the earlier subseral stages of the Lower High Forest Zone appear to be similar to those of adjacent zones. Fragmentary later subseral stages also show similarities with the later subseral stages of the adjacent zones.

This brief description of the inferred relationships of the earlier subseral stages is based on notes made since 1960. No detailed observations of subsequent stages have been made.

(1) Early Stages. Typical of the earliest stages of succession in old crop-lands are short-lived species of pioneer weeds, viz. *Bidens pilosa, *Erigeron floribundus, *Ageratum conyzoides, Commelina diffusa, Corchorus tridens, C. trilocularis, Cynodon dactylon, Hibiscus meeusei, Pavonia columella, *Physalis peruviana, *Richardia brasiliensis, Triumfetta annua, T. pilosa var. effusa, T. pilosa var. tomentosa, Chloris pycnothrix and Digitaria adscendens among others.

The foregoing weeds are accompanied or soon followed by the following herbaceous and suffrutescent to woody species:

Rhynchelytrum repens
Sporobolus pyramidalis
Eragrostis curvula
E. racemosa
Eriosema psoraleoides
Helichrysum adscendens
H. lepidissimum
H. nudifolium var.
H. odoratissimum
Indigofera schinzii
Laggera alata
Lippia javanica
Loudetia simplex
Nidorella auriculata
*Oenothera indecora
Paspalum commersonii
*P. urvillei
Polygala virgata
Senecio pterophorus
Sida rhombifolia
Sonchus oleraceus
Asclepias sp., cf. A. physocarpa
Astragalus atropilosulus subsp.
*Cassia laevigata
C. mimosoides
C. petersiana
Ceratotheca triloba
Chaetacanthus setiger
Clutia affinis
Conostomium natalense var.
Conyza pinnata
Cymbopogon validus
Cyperus albostriatus
Diospyros lycioides subsp.
Eriosema spp.
Eriospermum cooperi
Flemingia grahamiana
Helichrysum spp.
Hyparrhenia hirta
Hypoestes aristata
Indigofera arrecta
Justicia anagalloides
Leucas martinicensis
Mariscus sieberianus
Pellaea viridis
Pseudarthria hookeri
*Psidium guajava
Pteridium aquilinum
Pycnostachys urticifolia
Scabiosa columbaria
Schizachyrium semiberbe
Senecio erubescens forma
S. sceleratus
Setaria flabellata
S. sphacelata
Tephrosia macropoda
T. polystachya
T. shiluwanensis
T. zombensis
Vernonia ampla
V. corymbosa
V. natalensis
V. shirensis
Wahlenbergia spp.

(2) Later Stages. Acacia ataxacantha, Canthium huillense or Parinari curatellifolia subsp. mobola may enter the sere at an early stage or later, either in more or less pure stands or accompanied by other large woody species, occurring singly or gregariously, such as the following:

Acacia davyi	Nuxia congesta
Brachylaena transvaalensis	N. floribunda
Catha edulis	*Psidium guajava
Choristylis rhamnoides	Rhus chirindensis forma
Combretum gueinzii	R. intermedia
C. kraussii	R. rehmanniana
Cussonia spicata	Rubus sp. (cf. Scheepers 750)
Dombeya burgessiae	R. pinnatus
Euclea crispa	Syzygium cordatum
Faurea speciosa	Trema orientalis
Ficus capensis	Trimeria grandifolia
Heteromorpha trifoliata	Ziziphus mucronata
Maesa lanceolata	Aphloia theiformis localised, occasional
Maytenus heterophylla	Dais cotinifolia to locally common

Because secondary consocies and associes dominated by Acacia ataxacantha, Canthium huillense and other species have been and will be described elsewhere (see p.22-6, Appendix A), and because these are generally very similar in structure and composition, only one example of the later stages of "old land" succession in the Lower High Forest Zone will be considered here, viz. the secondary Parinari curatellifolia subsp. mobola Consocies described below:

Secondary Parinari curatellifolia subsp. mobola Consocies. Because the stand on which the following description is based represents only a transient developmental stage, it will be only very briefly described. This seral scrub or "dwarf forest" stand is situated on the southwestern boundary of Fredericksdal at about 1200 m elevation.

Habitat. The sample investigated lies in the catchment of the Madikeleni Stream on a fairly steep slope near the transition from the High Scrub Forest Zone to the Lower High Forest Zone. The aspect varies from easterly to northeasterly. Mist may or may not occur frequently on this spot but it is certainly frequent somewhat higher upslope. The rainfall is locally probably relatively heavy owing to the southeasterly winds being forced suddenly upwards by the steep upper slopes of the Madikeleni Catchment upslope. Although fairly sheltered from most winds except from the southeast, the site is fully exposed to direct sunshine except in the late afternoon when this is cut off by the mountainside to the west.

The stand appears to have developed on land formerly cultivated by the Bantu and subsequently abandoned. It is now protected from further disturbance (see p. 12, Chapter I).

Structure and Composition. On the whole, the stand presents a very uniform aspect. Strata are not conspicuously differentiated, although several synusiae are represented.

(a) "Canopy". The "canopy" is closed and fairly uniform in height (about 3 m to 4 m), composed predominantly of a dense more or less even-aged stand of Parinari curatellifolia subsp. mobola. The dominant is accompanied by such species as Vangueria infausta, Acacia ataxacantha, Ficus capensis, Bridelia micrantha, Maesa lanceolata and Syzygium cordatum.

(b) "Understory" or Shrub Layer. This stratum (from about 1 m to about 2.5 m in height) consists largely of transgressive Bridelia micrantha, Parinari curatellifolia subsp. mobola, Pittosporum viridiflorum, Aphloia theiformis and Maytenus mossambicensis var. mossambicensis, together with a few fair-sized shrubs and small trees. The true components of this synusia include Flemingia grahamiana, Vernonia ampla, Rhus intermedia, Canthium huillense, Euclea crispa, Lantana mearnsii and Diospyros lycioides subsp. sericea.

(c) Field Layer. The floor of this dwarf forest is dominated by Galopina circaeoides, accompanied by Paspalum commersonii and Carex spicato-paniculata.

(d) Lianoid Plants. The above layers are bound together by Smilax kraussiana, Rubus pinnatus, Mikania cordata, Clematis brachiata, Solanum bifurcum and Stephania abyssinica.

(e) Epiphytes. The only epiphytes observed were foliose and fruticose lichens, e.g. species of Anaptychia, Parmelia, Ramalina, Sticta and Usnea. These are locally abundant in the crowns and upper branches of the "canopy" trees wherever conditions were favourable, i.e. where the normally contiguous crowns do not shade one another too much.

Ecological Notes. With the exception of Acacia ataxacantha and, perhaps, Maytenus mossambicensis var. mossambicensis, the associated and transgressive trees noted probably all have their seeds dispersed largely by birds. Although the dominant tree was in most, if not all, cases too young to bear fruit and so attract larger frugivorous birds like Purple-crested Louries, yet it seems quite likely that a considerable quantity of seed has been introduced by other birds seeking shelter and, perhaps, seeds, worms and insects.

It appears likely that, with continued protection, this community will develop first into a taller mature Parinari curatellifolia subsp. mobola Consocies and, at a later stage, into a P. curatellifolia subsp. mobola-Other Species Associes as the associated and transgressive trees attain maturity. It further seems probable that more and more facultative forest species, e.g. Cussonia spicata, will become established in due course. As these forest precursors pierce the canopy and eventually begin to shade out P. curatellifolia subsp. mobola, these scrub and scrub forest communities will eventually yield to rather scrubby subclimax and climax forest communities.

(B) SECONDARY COMMUNITIES OF PLAGIOSERAL ORIGIN

Plagioseral sites are limited in extent in the Lower High Forest Zone at present. Such sites are currently restricted to boundary firebreaks, e.g. Pisangkop-Mayland, extending continuously from the transition with the High Scrub Forest Zone to the transition with the Middle High Forest Zone. The composition of the plagioseral vegetation varies appreciably over this altitudinal range and with local variations in habitat (e.g. rockiness). The current plagioseral vegetation is, accordingly, only briefly treated below:

(1) Present Plagioseral Vegetation. The species composition of present plagioseral stands in the Lower High Forest Zone shows a considerable degree of affinity with those of the Low Country. Salient points of difference are indicated in the following list of additional species present (left-hand column) and Low-Country species absent (right-hand column) in the Lower High Forest Zone:

Additional Species Present

Acalypha schinzii
A. wilmsii
Alloteropsis semialata (Montane form)
Aloe boylei
Anthospermum herbaceum
Argyrolobium adscendens
Aristea ecklonii
Asclepias affinis
Aster peglerae
Berkheya setifera
Brachystelma pygmaeum (rocky sites)
Bulbostylis collina
B. oritrephes
Commelina ecklonii

Cyanotis nodiflora
Dierama medium
Digitaria apiculata
Eragrostis racemosa
Eulophia parvilabris
Euryops pedunculatus (rocky places)
Ficinia filiformis (rocky places)
Gerbera kraussii
Harveya coccinea
Helichrysum acutatum
H. adscendens
H. chrysargyrum (rocky places)
H. odoratissimum
H. platypterum (rocky places)
H. undatum
Hemizygia rehmannii (rocky places)
Hermannia cristata
Hibiscus sp., cf. H. aethiopicus var.
Knowltonia transvaalensis
Koeleria cristata
Pearsonia aristata
Pelargonium alchemilloides forma
Pentanisia prunelloides
Pimpinella transvaalensis
Polygala wilmsii
Psammotropha myriantha
Rhynchosia angulosa
Satyrium longicauda
Schizoglossum pachyglossum
Scilla glaucescens
Scilla natalensis
Selago elata
Selago natalensis
Senecio erubescens forma
Senecio junodii
Senecio serratuloides (↑)
Setaria flabellata
Stachys nigricans
Sutera accrescens
S. floribunda
Thesium asterios
Thunbergia natalensis
Vernonia sp., aff. V. monocephala
Vernonia hirsuta (Montane form)
Zaluzianskya maritima

Low-Country Species Absent

Aeschynomene nyassana
Albuca setosa (= A. pachychlamys)
Alloteropsis semialata (Low-Country form)

Argyrolobium transvaalense

Cenchrus ciliaris
Commelina benghalensis
Conyza aegyptiaca
Cyperus compactus
Digitaria diagonalis
Digitaria milanjiana
Eragrostis superba
Eulophia clavicornis vars.
Eulophia parviflora
Euphorbia trichadenia
Gerbera jamesonii
Gladiolus psittacinus sens. lat.
Heteropogon contortus
Hyparrhenia dissoluta
Hyparrhenia rufa
Imperata cylindrica
Indigofera hilaris
Ipomoea crassipes
Kohautia omahekensis
Lannea edulis
Lotononis eriantha
Mucuna coriacea
Myosotis afropalustris
Nidorella resedifolia
Oxalis depressa
Pentanisia angustifolia
Perotis patens
Polygala albida

Rhynchosia nervosa
Schizachyrium brevifolium
Schizoglossum cordifolium

Tragus berteronianus
Tryphostemma viride

Waltheria indica

(2) Subseres Developed on Former Plagioseral and Plagioclimax Sites. The course of secondary succession, reverting after the factors bringing about a deflected succession have ceased to operate, depends largely upon the nature of the local seed sources and the abundance of *Acacia ataxacantha* and other coppicing species before clearing, burning, grazing, browsing and other disturbance. Also important are the duration and nature of the disturbance and local site factors such as soil depth, altitude and aspect. Under this head, the more typical subseres following deflected succession in the Lower High Forest Zone are considered first, followed by an account of the secondary succession from a plagioclimax near the upper limit of the Lower High Forest Zone, i.e. marginal to the Middle High Forest Zone.

(2.1) More Typical Subseral Stages. Three distinct subseral stages following deflected succession will be briefly described as examples:

(a) Secondary Sour Grassveld
(b) Secondary *Canthium huillense* Consocies
(c) Secondary *Acacia ataxacantha* Consocies

(a) Secondary Sour Grassveld. In the early stages of recovery from disturbance and where invasion by woody plants is delayed, the community resulting from the plagiosere may be a more or less stabilised secondary sour grassveld composed, inter alia, of the following species:

Grasses	and	Grass-like Plants
Cymbopogon validus		*Albuca* sp., cf. *A. fastigiata*
Eragrostis curvula		*Anthericum* spp.
E. racemosa		*Aristea ecklonii*
Hyparrhenia cymbaria		*A. woodii*
H. gazensis		*Bulbostylis collina*
H. hirta		*B. oritrephes*
Loudetia simplex		*Carex spicato-paniculata*
Monocymbium ceresiiforme		*Cyanotis nodiflora*
Paspalum commersonii		*Cyperus albostriatus*
Rhynchelytrum repens		*Ficinia filiformis*
Schizachyrium semiberbe		*Fimbristylis dichotoma*
Setaria flabellata		*F. hispidula*
S. sphacelata		*Gladiolus woodii*
Sporobolus pyramidalis		*Hypoxis angustifolia*
Trachypogon spicatus		*Kyllinga cylindrica*
Andropogon schirensis var.		*Lapeirousia grandiflora*
Eragrostis capensis		*Mariscus sieberianus*
Koeleria cristata		*Moraea* sp., aff. *M. spathulata*
		Trachyandra saltii var.

Other Monocotyledons (infrequent)

Eriospermum cooperi	*Eulophia* spp.
Eucomis undulata	*Satyrium longicauda*

Plate 53 (a). Photograph taken in mid-1940's showing open nature of vegetation on northern to western slopes of Piesang Kop, except for eucalypt plantations.(Photo. Prof. T.W. Gevers)

Plate 53 (b). Photograph taken in 1961. Note more heavily wooded

Dicotyledonous Plants and Ferns

Acalypha punctata
A. schinzii
A. wilmsii
Artemisia afra
Aspilia africana
Athanasia punctata
Athrixia phylicoides
Berkheya setifera
Cassinia phylicaefolia
Chaetacanthus setiger
Cheilanthes hirta forma
Clutia affinis
C. monticola
Conostomium natalense var.
Conyza pinnata
Diospyros lycioides subsp.
Endostemon obtusifolius
Eriosema spp.
Eupatorium africanum
Flemingia grahamiana
Hebenstreitia comosa
Helichrysum acutatum
H. lepidissimum
H. nudifolium var.
H. odoratissimum
H. setosum
H. splendidum
H. umbraculigerum
Hemizygia rehmannii (rocky places)
Hibiscus sp., cf. H. aethiopicus var.
Hypericum spp.
Hypoestes aristata
Indigofera sanguinea
I. schinzii
Justicia anagalloides
J. cheiranthifolia
Knowltonia transvaalensis
Kohautia amatymbica
Lasiosiphon caffer
Leonotis dysophylla
Mohria caffrorum
Nidorella auriculata
Pelargonium luridum
P. alchemilloides
Pellaea quadripinnata
P. viridis
Pentanisia prunelloides
Plectranthus calycinus
Polygala virgata
Pseudarthria hookeri
Pteridium aquilinum
Pycnostachys urticifolia
Rhynchosia clivorum
Satureia biflora
Schistostephium heptalobum
Selago elata
S. natalensis
Senecio erubescens formae
S. junodii
Solanum aculeastrum
Sutera floribunda
Tephrosia spp.
Thunbergia atriplicifolia
Vernonia ampla
V. corymbosa
V. natalensis
V. shirensis
Wahlenbergia spp.

This secondary sour grassveld becomes progressively more rank and scrubby, thickening up to form various types of scrub by the intrusion and rapid increase of woody plants, especially Acacia ataxacantha and Canthium huillense, variously forming different consocies and associes.

This account of the secondary sour grassveld is necessarily generalised owing to the very fragmentary relics of such grassland remaining today. This is illustrated by the great increase in woody plants that has taken place on Piesang Kop since portion of Christinasrust became part of Westfalia Estate (see Plate 53 (a) and (b)). Two of the communities that have participated in this general thickening up — one in the secondary lower xeroclinal lithosere and one in the xeroclinal subsere near the upper limits of the Lower High Forest Zone — are described below.

(b) Canthium huillense Consocies. This secondary lithoseral scrub community is situated between the Faurea speciosa - Canthium huillense Associes (see p. 158-61) and the Parinari curatellifolia subsp. mobola Consocies (see p. 164-5), lying below and north to northwest of the Schizachyrium semiberbe - Rendlia altera - Loudetia simplex Associes (see p. 155-8). It lies, therefore, near to the transition between the Lower High Forest Zone and the High Scrub Forest Zone in the rain shadow on the northwestern slopes of Piesang Kop, Christinasrust, at an altitude of about 1300 m.

(i) Habitat. The slope is only slight to moderate north to northwest, exposed to sunshine at most times of the day, as well as to desiccating winds from north and west. The site is generally warm to hot, frost-free and sheltered from southerly and easterly winds. Long periods with negligible effective rainfall are experienced which are scarcely tempered by the infrequent mist.

The soil is shallow with frequent outcrops of granite gneiss. The site was formerly exploited by Bantu graziers, especially for their goats, and it was frequently burned (P.C. Smit, p.c.).

(ii) Structure and Composition. Although practically a closed community, consisting of a dense, almost uniformly spaced, even-aged nearly pure stand of the dominant species, this consocies can hardly be considered to have a closed canopy. Stratification is poorly developed. The following synusiae can, however, be distinguished:

Emergent Tree Layer. The "overstory" is poorly developed, consisting of very scattered family groups of Ficus capensis, with more numerous smaller emergent trees overtopping the dominant tree layer. The more numerous "emergents" include Acacia davyi, Combretum gueinzii, Faurea speciosa, Maesa lanceolata and occasional Acacia ataxacantha, Cussonia spicata, Euclea crispa, Faurea saligna, Heteropyxis natalensis and Nuxia congesta.

Dominant Tree Layer (about 2 m in height). This stratum is overwhelmingly dominated by small trees, amongst which Canthium huillense predominates. Canthium huillense is accompanied by more or less transgressive Acacia davyi, Faurea speciosa, Combretum gueinzii, Euclea crispa, Vangueria infausta and Rhus rehmanniana with occasional Acacia ataxacantha, Brachylaena transvaalensis, Heteromorpha trifoliata, *Psidium guajava, Rhus intermedia and Syzygium cordatum.

Shrub Layer. Except for transgressive Canthium huillense, the shrub stratum is poorly represented, consisting of some large shrubby Flemingia grahamiana, with a few fair-sized specimens of Vernonia ampla and V. corymbosa and occasional large Lippia javanica.

Field Layer:

Low Soft Shrubs, Undershrubs and Taller Subwoody Forbs and Ferns. This subclass is fairly well developed but very much subordinate to the dominant; The more abundant species are Endostemon obtusifolius, Hypoestes aristata and Rhynchosia komatiensis, accompanied by Conostomium natalense var. glabrum, small Flemingia grahamiana, Pteridium aquilinum, Anthospermum herbaceum, Schistostephium heptalobum, Triumfetta pilosa var. effusa, Athrixia phylicoides and Helichrysum panduratum, with occasional Indigofera schinzii, Justicia cheiranthifolia, Lantana mearnsii, Leonotis dysophylla, Lippia javanica and Phyllanthus nummulariaefolius.

Low and Soft Herbs and Ferns. This sublayer is poorly developed, being almost absent except for slight openings in the scrub, where the more abundant species are the grasses Rhynchelytrum repens, Setaria sphacelata, Hyparrhenia gazensis, H. cymbaria, Cymbopogon validus and Schizachyrium semiberbe, with localised colonies of Berkheya setifera and scattered Pellaea viridis.

Lianoid Plants. The most abundant climber is Smilax kraussiana which binds the dense scrub into an impenetrable thicket. This species is accompanied by the more robust Clematis brachiata and Sphedamnocarpus galphimiifolius, with occasional scrambling Acacia ataxacantha, Cephalanthus natalensis and Rhoicissus tridentata. Also present are less robust Abrus fruticulosus and Cyphostemma cirrhosum subsp. transvaalense with occasional Tragia rupestris.

Parasitic Plants. The hemi-epiphytic slender twiner Cassytha ciliolata, is a fairly frequent hemiparasite.

(iii) Ecological Notes. Apart from Canthium huillense regeneration, the reproduction of trees is not marked. The next most abundant transgressive trees are Faurea speciosa, Acacia davyi, A. ataxacantha, Combretum gueinzii, Euclea crispa, *Psidium guajava and Rhus rehmanniana, with occasional Brachylaena transvaalensis, Maytenus heterophylla, Heteromorpha trifoliata, Heteropyxis natalensis, Rhus intermedia and Syzygium cordatum. The aggregations or "family groups" of Ficus capensis appear to have arisen by vegetative propagation. Vegetative spread is also a property of Berkheya setifera, which spreads by means of elongated rhizomes, especially on disturbed sites.

This stand will apparently develop slowly, by way of a mature Canthium huillense Consocies, into some kind of closed Canthium huillense - Faurea speciosa - Other Species Associes, comparable with but denser and taller than the Faurea speciosa - Canthium huillense Associes to the south and west of it, described on p. 158-61. This community also shows affinities with other plagiosere-reversion communities in the Lower High Forest Zone (see p.28-9, Appendix A), the Upper High Forest Zone (see p. 231) and the subseral communities of the Marginal Mistbelt edging the Middle High Forest Zone along the Rakgwale Ridge (see p. 12-14, Appendix A).

(c) Acacia ataxacantha Consocies. This sample of Acacia ataxacantha scrub in the High Forest Belt is situated in the southeastern corner of the Westfalia Estate portion of Christinasrust, a short distance to the west of the eastern boundary firebreak on the upper northwestern slopes of Piesang Kop. The stand investigated lies at about 1400 m between the Hyparrhenia cymbaria-dominated communities of the summit (see p.47-8 , Appendix A) and incipient Acacia ataxacantha scrub (see p. 154-5). It thus lies close to the upper limits of the Lower High Forest Zone.

(i) Habitat. The site is exposed to sunshine at all times of the day and to most winds except those from the south. The climate is fairly cool, with considerably more mist than a hundred metres lower down, and probably fairly heavy precipitation as well, lying as it does near the uppermost edge of the rain shadow on the Piesang Kop xerocline.

The soil is, for the most part, a very humiferous, friable, granular dark red to brownish red ferrallitic clay loam. The rather shallow litter layer and the fairly deep layer of duff, including a deep humus layer, seem to point to a rapid decomposition of litter. This rapid decomposition would appear to be a function of both the relatively moist montane climate and the more easily decomposed small leaflets that make up so much of the litter. The fairly mature nature of the soil and the species composition of the stand suggest that this example of Acacia ataxacantha scrub is derived by secondary succession from formerly much-disturbed grazing lands. This is confirmed by comparison of past with present-day aerial photographs, and also by personal testimony (P.C. Smit, p.c.).

(ii) Structure and Composition. This is a closed-canopy community. Stratification is not clearly evident but several synusiae are present.

Overstory (upwards of 7.5 m in height). The only trees seen to emerge from the canopy seem to be relics of previous communities, viz. *Ficus capensis* and isolated *Nuxia congesta*.

Canopy. The canopy is uneven, varying from about 2.5 m to about 7 m in height. It is overwhelmingly dominated by *Acacia ataxacantha* almost to the exclusion of other species of which only a few occur, viz. *Acacia davyi*, *Nuxia congesta* and *Rhus intermedia*, with occasional relics, e.g. *Euclea crispa* and *Ziziphus mucronata*, together with isolated young *Brachylaena transvaalensis*, *Cussonia spicata*, *Faurea speciosa*, *Ficus capensis* and *Heteromorpha trifoliata*.

Shrub Layer (about 1 m to 2 m in height). The most abundant erect shrub is *Flemingia grahamiana*, accompanied by *Lantana mearnsii*, *Lippia javanica* and *Vernonia ampla* with occasional fully grown specimens of *Diospyros lycioides* subsp. *sericea*.

Field Layer (mainly up to about 1 m in height):

Low Soft Shrubs, Undershrubs and Tall Herbs and Ferns (mostly from about 0.5 m to 2 m tall). This subclass, as well as the field layer as a whole, is dominated by *Hypoestes aristata*, associated with the tall, sometimes scrambling grass, *Hyparrhenia cymbaria*. These more abundant plants are accompanied by the following species:

Cineraria fruticetorum	*Triumfetta rhomboidea*
Anthospermum herbaceum	*Cyphia elata*
Pavonia columella	*Pteridium aquilinum*
Crossandra greenstockii	*Tephrosia shiluwanensis*
Asparagus virgatus	*Sparmannia ricinocarpa*
Endostemon obtusifolius	*Athrixia phylicoides*
Justicia cheiranthifolia	*Desmodium repandum*
Senecio pandurifolius	*Schistostephium heptalobum*
Phyllanthus nummulariaefolius	*Vernonia hirsuta*
	Xysmalobium sp.?, cf. *X. orbiculare*?

Low Herbs and Ferns (mainly less than 0.5 m tall). This sublayer is dominated by *Galopina circaeoides*, with *Cyperus albostriatus* subdominant, accompanied by *Achyranthes argentea*, *Chlorophytum bowkeri*, *Gerbera jamesonii*, orchid? (*Satyrium* sp.?), and *Eulophia streptopetala*, with occasional *Acalypha wilmsii*, *Commelina* sp., *Setaria sphacelata* and *Zantedeschia tropicalis*.

(e) Ground Layer. A ground layer is not developed probably because of the continuous rain of litter on the ground.

(f) Lianoid Plants. Besides the scrambling dominant *Acacia ataxacantha*, the more abundant lianes and scramblers are *Sphedamnocarpus galphimiifolius*, *Clematis brachiata*, *Smilax kraussiana* and occasional *Canthium gueinzii*. *Rhoicissus tridentata* reaches the canopy only very rarely.

Most abundant among the less robust climbers and scramblers, is *Senecio deltoideus*, associated with *Adenia digitata*, *Rhoicissus tridentata*, *Rhynchosia caribaea*, *Abrus fruticulosus*, *Littonia modesta*, *Thunbergia alata*, *Cissampelos torulosa*, *Dioscorea retusa* and *Dumasia villosa*, with occasional *Asparagus africanus*, *A. asparagoides*, *Cyphia transvaalensis* and *Trochomeria hookeri*.

(g) Epiphytes. A fair quantity of epiphytic lichens are present especially in the crowns of the canopy trees, where species of *Parmelia*, *Ramalina* and *Usnea* are conspicuous. The ferns *Pleopeltis macrocarpa* and *Polypodium polypodioides* subsp. *ecklonii* and the orchid *Polystachya ottoniana* are found as rather infrequent epiphytes on the rougher bark of older trees.

(iii) Ecological Notes. The most rapid reproduction by woody species other than *Acacia ataxacantha* appears to take place in the vicinity of large old relic trees bearing edible "fruits", such as *Ficus capensis* and *Ziziphus mucronata*. In the case of several species, at least, this is, apparently, owing the introduction of seeds by fruit- and seed-eating birds such as Purple-crested Louries. It seems that there will be a tendency for these trees to spread through the *Acacia ataxacantha* Consocies from these "nuclei". The succession appears, for the time being, to be tending towards a type of marginal rain-shadow scrub-forest community composed of *Acacia ataxacantha*, *Cussonia spicata*, *Euclea crispa*, *Heteromorpha trifoliata*, *Rhus intermedia*, *Trimeria grandifolia*, *Maesa lanceolata*, *Maytenus heterophylla*, *Canthium inerme*, *Fagara davyi*, *Pittosporum viridiflorum*, *Rhamnus prinoides* and *Rhus chirindensis* forma *legatii*, with occasional *Brachylaena transvaalensis*, *Canthium huillense*, *Prunus africana*, *Rhus transvaalensis* and *Ziziphus mucronata*. This marginal type of scrub forest may at a later stage develop into a marginal type of (sub-)climax forest dominated by *Cussonia spicata* (cf. p. 244-50). Further succession is likely to be somewhat retarded owing to the marginal rain-shadow conditions.

(2.2) Upper-Level Subseral Stages. The lower xeroclinal slopes of the sour mountain grassveld glade of upper Rosendal are considered to fall into the Lower High Forest Zone. Because the greater portion of this glade is considered to fall into the Middle High Forest Zone and its broad lower ecotone, the overall composition and environmental factors prevailing over the glade are discussed under the Middle High Forest Zone (see p. 35 *et seq.*, Appendix A).

The overall composition of the glade was sampled along five contours designated A, B, C, D and E in order of descending altitude. The aspect of contour E (about 1300 m elevation) veers around from 105° east at the southern end of the glade to about 65° east to roughly due north in the scrub to the northwest. Contour E is bounded on the south by the *Scolopia zeyheri*-*Rapanea melanophloeos*-Other Species Associes (see p.29-32, Appendix A) and on the west by a *Syzygium gerrardii*-other species postclimax gallery and kloof forest along a tributary rivulet of the upper Mtataspruit. The southern end of the glade along this contour lies over the formerly most eroded part of the lower portion of the glade which was subsequently contour trenched. Contour trenches can still be seen and they have provided sites for the establishment of several invading trees, e.g. *Nuxia floribunda*. The old waggon tracks at the southern extremity of the glade and on the watershed to the north, and the more disturbed and eroded intervening parts of the contour carry a rather low growth of grasses, especially *Eragrostis curvula* and *E. racemosa*. Towards the northern aspect of contour E, the glade thickens up into scrub and scrub forest as briefly discussed below.

(a) Early Stages. The more open parts of the more xeric lower portion of the glade consist of a short to rank sour grassveld. Cover is mainly provided by the grasses *Paspalum commersonii*, *Cymbopogon validus*, *Loudetia simplex*, *Digitaria apiculata*, *Eragrostis curvula*, *E. racemosa* and *Hyparrhenia hirta*. *Cymbopogon validus* is fairly frequently scattered throughout, becoming locally conspicuous to abundant in places on the slopes to the north of the watershed. *Digitaria apiculata* is locally abundant to very abundant, especially lower down and to the south of the watershed, where the Cyperaceous *Fimbristylis* sp. (cf. *F. hispidula*?) may also be locally fairly frequent. *Sporobolus pyramidalis* may also be quite frequent locally, especially lower down on the more disturbed sites but many of the tufts are now moribund and the remainder usually small. *Rhynchelytrum repens* and *Schizachyrium semiberbe* seem at present, to be mainly restricted to the more xeroclinal aspects. *Monocymbium ceresiiforme* is also fairly prevalent particularly, it seems, to the south of the watershed, i.e. marginal to the Middle High Forest Zone.

Trachypogon spicatus seems to be rather less frequent on the whole except, locally, on the more easterly to northeasterly slopes. Occasional tufts of *Andropogon filifolius* also occur, especially south of the watershed, i.e. marginal to the Middle High Forest Zone. Infrequent small aggregations of *A. schirensis* var. *angustifolia* occur in places on the north-facing slopes in particular.

Pteridium aquilinum may be locally very abundant forming sometimes dense thickets, particularly just to the south of and over the watershed below and appearing more to the north upwards. *Conostomium natalense* var. *glabrum* appears to be the most abundant species of the associated forbs which include several species of *Helichrysum*. In addition, there is much encroachment south of the watershed lower down by *Cassinia phylicaefolia* and *Hypericum revolutum*. *Cassinia phylicaefolia* and *Digitaria apiculata* are particularly abundant on the eroded portions at this level, associated with *Helichrysum odoratissimum* and *H. lepidissimum*, together with lichens and other cryptogams (cf. p.33-4, Appendix A). To the west, north of the watershed, there is also much encroachment by *Flemingia grahamiana*, *Hypericum revolutum* and *Nuxia floribunda*. *Flemingia grahamiana* and *Hypericum revolutum* are fairly frequent to locally abundant throughout with *Lippia javanica* and *Vernonia ampla*.

(b) *Later Stages*. The later subseral stages of the lowermost northerly to northwesterly slopes of the glade are regarded as being more typical of the Lower High Forest Zone. Northwards and westwards from the watershed, the glade gets progressively more rank and scrubby with much *Cymbopogon validus* and encroachment by *Canthium huillense* and *Flemingia grahamiana*, with much *Hypericum revolutum*, *Lippia javanica*, **Psidium guajava*, *Vernonia ampla*, *Conyza ivaefolia* and *Rhynchosia clivorum*, together with *Cassinia phylicaefolia* (↑) and *Helichrysum odoratissimum* (↑), occasional *Vernonia corymbosa* and isolated *Cassia petersiana* (↓). These species may thicken up into a low scrub with the addition of such small trees and shrubs as *Euclea crispa* and *Rhus intermedia*. Also present are the climbers *Smilax kraussiana* and *Sphedamnocarpus galphimiifolius*, together with much growth of the hemi-epiphytic, hemiparasitic twining *Cassytha ciliolata* and numerous epiphytic lichens, e.g. species of *Ramalina* and *Usnea*.

This low scrub gives way in places to taller scrub and scrub forest. In addition to the scrub components mentioned above, *Maesa lanceolata*, *Aphloia theiformis*, *Cussonia spicata*, *Acacia ataxacantha*, *Dombeya burgessiae*, *Rapanea melanophloeos*, *Nuxia floribunda* and *Heteromorpha trifoliata* may also occur. The margins of these clumps of scrub and scrub forest typically consist of species such as *Canthium huillense*, *Acacia ataxacantha*, *Endostemon obtusifolius*, *Polygala virgata* and *Pteridium* aquilinum, much entangled with Smilax kraussiana, Sphedamnocarpus galphimiifolius and Cassytha ciliolata, although any of the above-mentioned forest precursors may also be present.

Even the currently more open parts of the lower slopes north of the watershed provide ample evidence of the direct invasion of short sour grassveld by scattered seedlings of trees, shrubs and lianoid plants. In addition to Flemingia grahamiana, Heteromorpha trifoliata, Hypericum revolutum, Pteridium aquilinum, Rhamnus prinoides, Smilax kraussiana, Vangueria infausta, Vernonia ampla, Acacia ataxacantha, Canthium gueinzii, C. huillense, C. inerme and Lippia javanica, the following trees are invading the grassveld direct:

Maesa lanceolata	Brachylaena transvaalensis
Nuxia floribunda	Combretum kraussii
*Psidium guajava	Croton sylvaticus
Rapanea melanophloeos	Curtisia dentata
Cussonia spicata	Dovyalis zeyheri
Nuxia congesta	Ficus capensis
Pittosporum viridiflorum	Halleria lucida
Rhus intermedia	Myrica pilulifera
R. chirindensis forma	Parinari curatellifolia subsp.
Aphloia theiformis	Syzygium cordatum

All the indications are that, if protection from disturbance continues, this subsere will bring about the relatively rapid conversion of the lower xeroclinal slopes of the glade from the present short to rank and scrubby sour grassveld into a rather scrubby high forest.

An example of an intermediate type of seral scrub forest developed on the mesoclinal slopes is provided by the Scolopia zeyheri - Rapanea melanophloeos - Other Species Associes described below.

(c) Scolopia zeyheri - Rapanea melanophloeos - Other Species Associes. This scrub forest lies just to the south of the old waggon track skirting the southeastern corner of the glade in the vicinity of contour E, a short distance to the south of the northern watershed of the Madikeleni Catchment. It can be considered to lie within or close to the broad ecotone between the Lower and Middle High Forest Zones. Although the past history of the single stand seen is uncertain, it will be discussed here, under the subseres, for convenience.

(i) Habitat. The stand is located at the head of the northernmost of the Madikeleni-headwater kloofs, at about the 1300 m level. The ground is variably sloping with a general easterly aspect. The site is fairly sheltered, lying in a shallow kloof or depression on the hillside, exposed to winds from northeast through east to south.

Lying at the bottom of the glade as it does, although only a relatively short distance below the watershed, the trees, at least, probably benefit in some measure from the accretion of groundwater from higher upslope.

There is some evidence of former disturbance and erosion in the form of apparently water-worn channels running downslope. The nature, degree and duration of the disturbance and erosion are not known but the erosion seems to be at least partly attributable to excessive run-off from the disturbed patches of grassveld lying upslope of this scrub forest. The single stand was very heterogeneous in composition when studied, with abundant changes likely to be ushered in, in the foreseeable future, as noted in the following account.

(ii) Structure and Composition. This is a closed-canopy community. Strata are for the most part poorly differentiated although several synusiae are present:

Canopy. The canopy is more or less closed, low and fairly uniform in height, mostly up to about 6 m but up to about 8 m in places. The dominant tree layer is mixed in composition and this scrub-forest community is difficult to name on that account. The most abundant species contributing to the canopy are undersized trees of *Scolopia zeyheri*, especially towards the margin, and *Rapanea melanophloeos*. They are accompanied by scattered *Brachylaena transvaalensis* (to 8 m), *Combretum kraussii*, *Ficus capensis* (to 8 m), *Maesa lanceolata* (margin), *Nuxia congesta* (especially towards the margin), *Pittosporum viridiflorum* (to 8 m), *Syzygium gerrardii* (to 8 m) and *Trimeria grandifolia* (to 6 m).

Understory (from about 2.5 m to about 5 m in height). An understory can only be differentiated from the canopy and the shrub layer with great difficulty owing to the low canopy but there is evidence that an understory is developing. Although typical understory trees, e.g. *Trimeria grandifolia*, do occasionally contribute to the canopy in places, this is likely to occur less frequently as the height of the general canopy increases. Understory components present include fully grown *Clausena anisata* (towards margin) and *Eugenia natalitia*, *Grewia occidentalis*, *Maesa lanceolata* (towards margin), exceptionally large specimens of *Maytenus mossambicensis* var. *mossambicensis* and *Rhamnus prinoides* (margin), *Tricalysia capensis* and *Trimeria grandifolia*.

Shrub Layer (about 1 m to about 2 m tall). The shrub stratum consists mainly of transgressive trees. Shrubs proper are poorly represented except for numerous average-sized specimens of

Maytenus mossambicensis var. mossambicensis and an isolated few Vernonia ampla shrubs under canopy openings.

Field Layer (up to about 1 m in height). This stratum is well represented in numbers of individuals although poor in species. It is dominated by the undershrub Phaulopsis imbricata, associated with Hypoestes verticillaris. The associated low herbs and ferns form a poorly differentiated sublayer which consists predominantly of monocotyledonous herbs and ferns. It is dominated by Dietes vegeta, accompanied by Cyperus albostriatus, Pellaea viridis, Chlorophytum comosum and Dryopteris inaequalis, together with occasional Carex spicato-paniculata, Haemanthus magnificus and Setaria chevalieri.

Lianoid Plants. Scandent and subscandent plants are rather poorly represented, especially the smaller softer forms. The more robust lianes and scramblers capable of reaching the canopy include Smilax kraussiana, Jasminum streptopus var. transvaalense, Secamone gerrardii and S. alpinii, with occasional Cephalanthus natalensis, Cnestis natalensis and Rubus pinnatus.

The only soft slender twiners noted were Behnia reticulata and Cissampelos torulosa.

Epiphytes. The only vascular epiphyte seen was Pleopeltis macrocarpa.

(iii) Ecological Notes. Nothing seems to be known of the history of this scrub forest. It may possibly have arisen from disturbed grassveld or scrub. The widespread establishment and robust growth of woody seedlings portend imminent changes in composition. The indications are that this scrub forest will thicken up and increase in height in the near future, resulting in a rather scrubby but more distinctly stratified high-forest community of mixed composition. Certain synusiae are likely to include the following species:

Canopy:

Scolopia zeyheri, Rapanea melanophloeos, Syzygium gerrardii, Aphloia theiformis?, Bersama sp., cf. B. transvaalensis?, Maytenus peduncularis, Pittosporum viridiflorum, Brachylaena transvaalensis, Combretum kraussii, Ficus capensis, Nuxia congesta and Protorhus longifolia, with Rhus intermedia along the margins and under canopy openings;

Understory:

Bersama sp., cf. B. transvaalense (transgressive?) Clausena anisata, Trimeria grandifolia, Tricalysia capensis and Eugenia natalitia, with Grewia occidentalis scrambling and under open canopy;

Field Layer:

Hypoestes verticillaris will possibly assert dominance over Phaulopsis imbricata and Dietes vegeta is likely to be joined by Oplismenus hirtellus.

Appearances suggest that the succession is tending eventually towards a community comparable to the Syzygium gerrardii - Other Species Postclimax Association of the Middle High Forest Zone, developed farther south and higher upslope (see p. 224-7). In view of the situation and, therefore, of a probably less-favourable moisture regime, a community dominated by Syzygium gerrardii and Cussonia umbellifera, for instance, may be unable to develop. In this case, the succession may be culminated by a climax or postclimax association with a canopy composed, inter alia, of the following species:

Scolopia zeyheri
Rapanea melanophloeos
Syzygium gerrardii
Bersama sp., cf. B. transvaalensis?
Brachylaena transvaalensis
Combretum kraussii
Protorhus longifolia
Apodytes dimidiata?
Celtis africana?
Croton sylvaticus
Cryptocarya liebertiana
Curtisia dentata

possibly Cussonia spicata
C. umbellifera
Fagara davyi
Ficus craterostoma
Kiggelaria africana
Nuxia congesta
N. floribunda
Olea capensis subsp.?
Prunus africana
Rhus chirindensis forma
Trichilia dregeana
Xymalos monospora

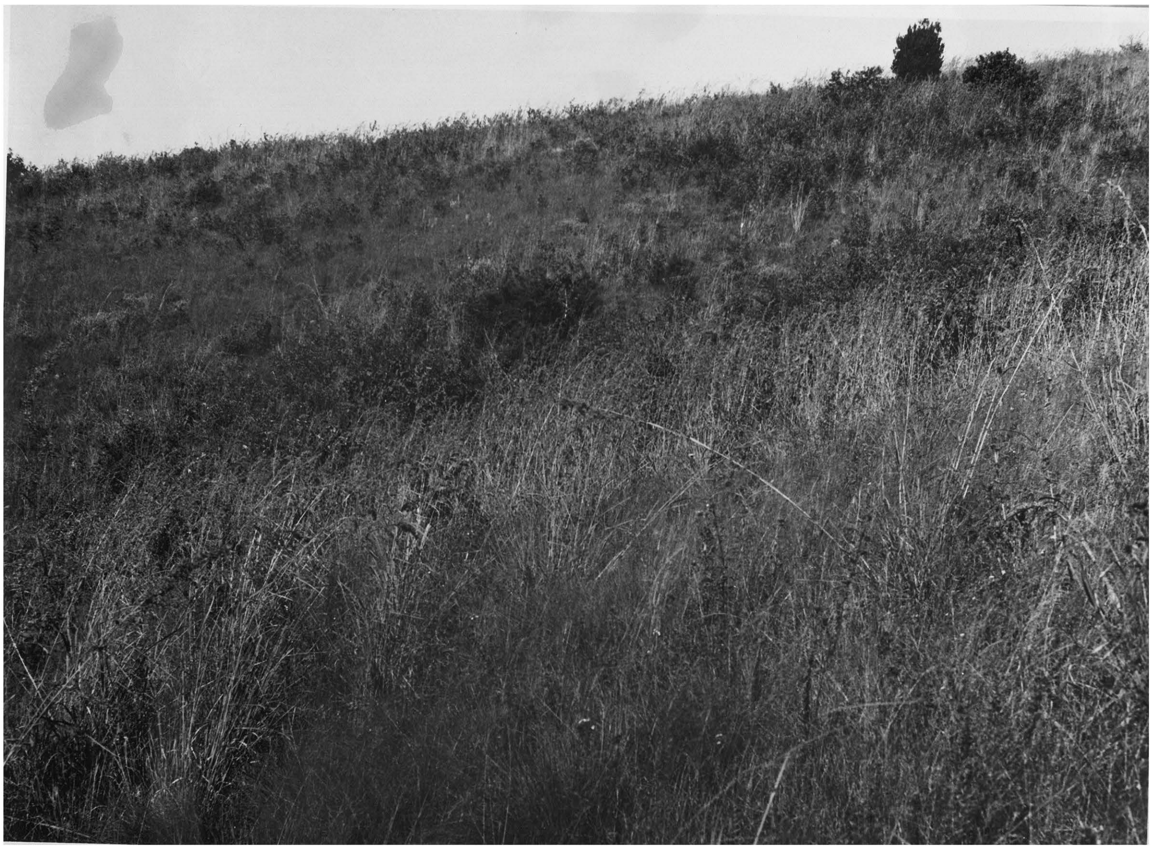

Plate 55. North-facing "depression" between contours C and D, mountain sourveld glade, Rosendal.

3.2 THE MIDDLE HIGH FOREST ZONE

The secondary communities fall into two main groups:

(A) Those developed on former cultivated lands

(B) Those developed on plagioseral and former "plagioclimax" sites.

These groups are dealt with in that order:

(A) SECONDARY SUCCESSION ON ABANDONED CROP-LANDS

The first subseral community to be described here is that which has arisen in the old potato- and maize-lands (see p. 9) a short distance to the south of the northern watershed of the Madikeleni catchment at about 1400 m elevation in the glade described on p. 35 et seq., Appendix A). To the south of the watershed, the glade between contours A and B is largely occupied by old crop-lands.

The succession on bared mineral soil is initiated by Algae, crustose and, later, fruticose lichens, e.g. Cladonia sp. (Scheepers 1175), accompanied or followed by small hepatics (Jungermanniales?) and mosses, and by ferns and seed-plants, e.g. Eragrostis racemosa, Helichrysum adscendens and H. fulgidum var. monocephalum.

The old crop-lands now mainly carry a short sour grassveld of Digitaria apiculata, Eragrostis racemosa, Paspalum commersonii, Setaria sphacelata, E. curvula and Sporobolus pyramidalis with Aristea woodii, Senecio isatideoides, S. junodii, S. pterophorus, Crassocephalum crepidioides, Selago elata, Buchnera brevibractealis and Mohria caffrorum. This grassveld is in an advanced stage of encroachment by species of Helichrysum, notably H. chrysargyrum, H. odoratissimum and H. umbraculigerum with occasional H. splendidum, H. nudifolium var. quinquenerve, H. adscendens (relic pioneer), H. fulgidum var. monocephalum and H. lepidissimum, and isolated Cassinia phylicaefolia (see Plate 54). Parts of the old crop-lands especially near the edges and leys are in advanced stages of invasion by Hypericum revolutum. Pteridium aquilinum, too, is encroaching on the old crop-lands especially along the leys where Parinari curatellifolia subsp. mobola has also been seen.

Immediately below the southern end of contour B, the southern edge of the old crop-lands shows marked encroachment by Erica woodii (var. robusta?). This low-spreading shrublet extensively covers the ground between clumps of Helichrysum chrysargyrum and scattered Hypericum revolutum, Smilax kraussiana and Pteridium aquilinum, with Carex spicato-paniculata, Pellaea viridis, Tephrosia shiluwanensis, T. zombensis, Clutia affinis and species of Helichrysum, especially H. adscendens (relics of pioneer stage). The usual grasses, ferns and forbs, e.g. Plectranthus calycinus, Selago elata and Senecio junodii, are present. Also present are small trees such as Aphloia theiformis, Buddleia salviifolia, Myrica pilulifera, Nuxia floribunda, Rapanea melanophloeos and Pittosporum viridiflorum, together with the hemiparasitic Cassytha ciliolata and a few other lianoid plants.

Other subwoody and woody plants invading directly are Clutia affinis, Flemingia grahamiana, Lippia javanica and Vernonia ampla with occasional Canthium huillense, Solanum aculeastrum, Vernonia corymbosa, Rhamnus prinoides, Maesa lanceolata, Combretum kraussii, Halleria lucida, Heteromorpha trifoliata and Nuxia floribunda.

The succession on the old crop lands will probably proceed very rapidly with the early establishment of woody plants by direct invasion as well as rapid encroachment from the edges. It seems likely that this subsere will converge on the adjacent subseres next to be described and will proceed by way of similar stages of scrub and scrub forest to high forest.

(B) SECONDARY COMMUNITIES OF PLAGIOSERAL ORIGIN

Secondary communities resulting from deflected succession in the Middle High Forest Zone can be subdivided into the more typical secondary communities of the Middle High Forest Zone and the more specialised communities of the summit of Piesang Kop, transitional to the Upper High Forest Zone.

(1) More Typical Secondary Communities of Plagioseral Origin.

(1.1) Present Plagioseral Vegetation. The more typical plagioseral vegetation of the Middle High Forest Zone is, at present more or less restricted to the eastern portion of the Christinasrust-Pisangkop boundary firebreak. The species composition of this plagioseral vegetation is similar to that of the Lower High Forest Zone (p.18-9,Appendix A). The few additional species include Aeschynomene rehmannii var. leptobotrya, Berkheya setifera, Digitaria monodactyla, Eriosema polystachyum, Helichrysum fulgidum var. monocephalum, H. miconiaefolium, Kohautia amatymbica, Pachystigma venosum (rocky sandy soil), Psoralea wilmsii, Schizachyrium jeffreysii (rocky site), Senecio coronatus, Tulbaghia alliacea and Urginea pretoriensis.

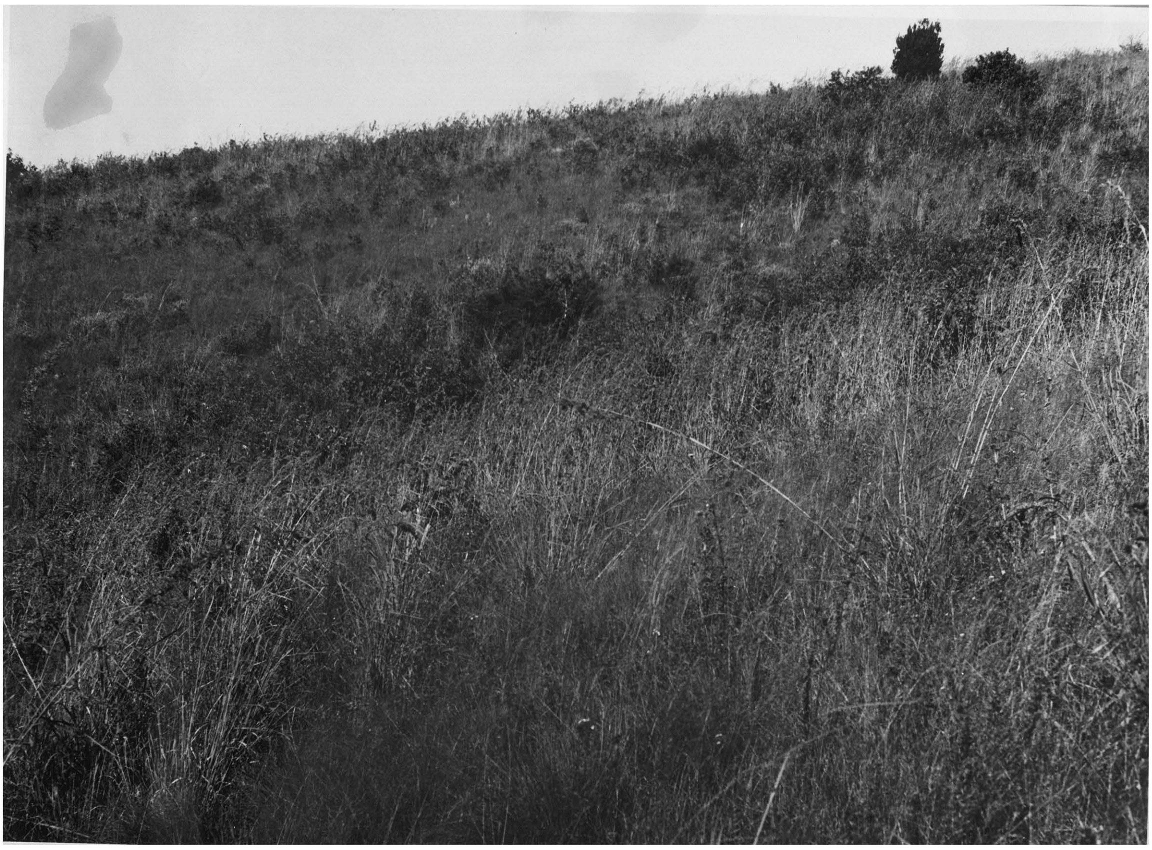

Plate 55. North-facing "depression" between contours C and D, mountain sourveld glade, Rosendal.

(1.2) Subseres Developed on Former Plagioseral and Plagioclimax Sites on the Main Escarpment Slopes.

(a) *Paspalum commersonii* - *Helichrysum odoratissimum* - *Loudetia simplex* Associes. To the west and north of the large shallow "hollow" formed by the shallow kloofs containing the headwaters of the Madikeleni Stream, lies a large glade spreading for a considerable distance on either side of the watershed between the Madikeleni and the upper Mtataspruit catchments. The glade extends from about 1300 m up to slightly over 1433 m in elevation, just entering the Grootbosch Government Forest Reserve. A large portion of the glade corresponds to the broad ecotone whereby the Lower High Forest Zone (see p.27-8, Appendix A) merges imperceptibly with the Middle High Forest Zone.

(i) Habitat. As indicated above, the range in altitude is a little over 133 m. The approximate lengths and altitudes of the contours used in sampling this glade are set out in Table 19, together with the aspects at the ends of these contours and slopes on the watershed. The most southerly and the most westerly aspects on the contours are those given in Table 19 for the southern and western ends respectively, except in the case of contours D and C. The most southerly aspect on contour D is 125° east of north, while the most westerly aspect on contour C, viz. 55° west of north, is to be found on the eastern side of a large shallow depression on the northern slope (see Plate 55). The most northerly aspect on contour E is 65° east in the more open parts veering around to almost due north in the scrubby vegetation encroaching on the grassveld. There is also an appreciable variation in gradient of which the inclinations on the watershed given in Table 19 provide some idea. Gradients away from the watershed may be much steeper in places but no data are available. On the whole, the slope varies from gentle in the upper portion becoming progressively steeper to moderate below.

It is reasonable to assume that the local climate will vary with altitude and aspect and also, to some extent, with slope. Potential evapotranspiration presumably decreases upwards and southwards from the lower and westerly to the upper northerly to easterly slopes. The northerly to westerly aspects are much more intensely insolated than the easterly to southerly slopes. The upper slopes receive more mist than the lower slopes and probably lower mean and maximum temperatures as well. The upper slopes probably have higher minimum temperatures than the lower slopes which are, however, probably frost-free owing to the good air drainage prevailing on the spur on which the glade is situated.

TABLE 19. Altitudes of the contours sampled with the aspects of their extremities and the slopes between the contours on the watershed, Rosendal glade.

Contour	Approx. length	Altitude	Aspect		Slope on Watershed	
			Southern end	Western end	Between contours:	Slope in degrees from horizontal
A	100 m	1426 m	95°E	7½E	A & B :	9°
B	500 m	1395 m	127½°E	30°W of North (330°E)	B & C :	9° to 7° to 10°
C	450 m	1365 m	130°E	due N	C & D :	10° to 12°
D	500 m	1334 m	122½°E	35°W of North	D & E :	Approx. 12°
E	500 m (incl. scrub)	1304 m	105°E	65°E (± N in scrub)	below E:	" "

The easterly to southerly slopes are, on the whole, more exposed to wind than the northerly to westerly slopes, owing to the protection afforded by the ridge to the north and the spur to the west. The southerly to easterly winds are often moisture-bearing which probably more than compensates for the times when they are desiccating. Because of the moderate gradients and the less tussocky grass cover, infiltration probably tends to be better on the upper slopes than lower down on comparable soil sites. Run-off from severe storms may be considerable, however.

The soils are mostly rather variable yellowish to reddish* ferrallitic sandy clay loams. They are mainly fairly deep but vary in depth being quite shallow in parts along the watershed. Soil pits were dug on the top, middle and bottom contours (e.g. see Table 20). Topsoils are normally more or less humiferous. Sometimes the layer of litter and organic matter is remarkably deep, while elsewhere there is a greater or lesser measure of erosion. The topsoil may be grey-brown in places especially lower down on the xeroclines (mostly considered to fall into the Lower High Forest Zone, see p. 27 et seq., Appendix A) where, presumably, a brown drift soil could develop were there better opportunities for humus accumulation. Apart from the history of burning and erosion (discussed below), humus accumulation has apparently been precluded on the sunnier, warmer and drier sites by higher oxidation rates prevailing there.

This and similar mountain sourveld glades would seem to owe their existence originally to the herds of game which, from prehistoric times, probably exerted heavy though periodic grazing and browsing pressure on the more open parts of the Escarpment slopes. This periodic use by game would coincide with their annual migrations between the Lowveld to the east and the Mountain Sourveld to the west. Fires would also tend to keep this sour grassveld open because of the fierce heat engendered by the copious quantities of inflammable plant material produced each growing season.

Deliberate burning has ceased since the late thirties although grazing continued on the glade for several years (see p. 6 & 9). The steeper lowest levels, i.e. near to contour E, were contour-trenched where erosion was worst to break the force of storm-water run-off. With the inception of the hydrological investigations on the Madikeleni Stream, those portions of the glade north of the northern watershed, as well as the entire catchment, have been completely protected from fire, grazing and other disturbance. The vegetation of this glade has thickened up a

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* For explanation of colour differences see p. 22.

TABLE 20. Profile description* of soil pit on middle contour (about 1365 m elevation) on watershed north of Madikeleni catchment in Rosendal: moderately shallow, strongly laterised ferrallitic red sandy clay loam over granite-gneiss.

Horizon	Depth	Description
A_1	0- 18 cm	Dusky red (2.5YR 3/2) sandy clay loam: gritty, massive, slightly hard, some small quartz stones, abundant grass roots, pH 5.3
B/C	18-107 cm	Red brown (2.5YR 5/4) sandy clay: gritty, massive, soft, 50% half-decomposed boulders of granite-gneiss, increasing to the bottom, few roots, pH 5.3
C_1	107-140 cm	Red (2.5YR 5/6) clay loam, decomposed granite-gneiss, massive, soft, many boulders, some flakes of mica, pH 5.3
C_2	140-178 cm	Red (10R 5/6) sandy clay loam: decomposed granite-gneiss, massive, soft, many boulders, some flakes of mica, (drainage slightly impeded ?) pH 5.2

* Adapted from original tabulated description of Profile 65 by H.C. von Christen (Unpubl.).

great deal since it has been protected and erosion has all but ceased. Succession is proceeding rapidly with the encroachment of scrub and forest from the sides (see Plate 59) and the invasion of the grassveld by forest precursors as isolated pioneers and in thickets of bracken and woody growth (see Plates 56, 57 & 58). These forest precursors then act as nuclei in the formation of bush-clumps (see Plate 59).

(ii) Structure and Composition. The glade was sampled in 1961-62 with a view to making comparisons at some later stage and tracing the course of succession. The following description is based on the data obtained, viz. estimates of numerical abundance and cover derived from twenty 10 m transects in a stratified random sample. A transect method was thought to be the most suitable for the simultaneous investigation of species composition, numerical abundance, cover and frequency in the limited time available. The 20 transects were distributed at random, at the rate of four per contour along and at right angles to five contour lines previously pegged out at 100 ft (30.48 m) height intervals. This sampling procedure gave the following overall results:

Relative Density. The more numerous species mentioned are each followed by an approximated percentage of the number of individuals recorded of the species concerned against the total number of all plants recorded. Each of these percentages is given as a rough indication of the percentage relative numerical abundance of the species in the glade as a whole.

The short grass Paspalum commersonii (33.69 per cent) was the most abundant individual species counted. The most numerous associated species were the forb Helichrysum odoratissimum (13.98 per cent) and the grass Loudetia simplex (10.39 per cent) accompanied by the species listed in Table 21.

In Table 21, the names of grasses and grass-like plants are followed by the letter "G". It can be seen that these plants are more abundant in numbers of individuals than any other life form. All told, of the 33 more abundant species sampled, 20 are grasses or grass-like plants, as contrasted with only 6 species of the remaining 34 less abundant species sampled.

Cover. Rough estimates of cover can be derived from the data obtained by measuring the intercepts recorded for each individual plant along the steel measuring tape used in demarcating the 10 m long transects. The transect method adopted was not a true line

Plate 56. Early stage of bush-clump succession showing colonisation of bushy Aphloia theiformis by Cussonia spicata, Maesa lanceolata and Acacia ataxacantha.

transect or line intercept method as used by Canfield (1941), but resembles the method tried at first by Anderson (1942) and employed by Parker and Savage (1944), Evans and Cain (1952) * and Whitman and Siggeirson (1954) in that the measurements of intercepts are made within a narrow belt transect, in this case the width of the steel tape, viz. 1 cm. In other words, the dimensions of the intercepts in centimetres can be read off directly as expressions of area in square centimetres. These areas, as well as the intervening areas of bare ground, are readily converted into percentage estimates of cover within the 1000 cm long transect (i.e. 1000 cm^2 in area) by shifting the decimal point one place to the left.

Intercept readings were taken of all plant stems in direct contact with the tape. As in the line intercept methods of Anderson (ibid.) and Parker and Savage (ibid.), a distance of less than 1 cm between plant stems is regarded as solid vegetation cover, and a distance of more than 1 cm is regarded as bare ground. Grasses, grass-like plants and forbs were measured at ground level where their bases fell within the transect. Otherwise, only those portions of forbs' stems actually falling within the transect were measured. This also applied to those sections of sprawling to trailing stems, e.g. of *Helichrysum odoratissimum* and *Tephrosia macropoda*, falling across the line of the transect. A minimum value of 1 cm per single stem was accorded to these and single-stemmed forbs. Rosette ferns were treated as forbs. Each frond of *Pteridium aquilinum* was counted as an individual plant and the basal intercepts only were measured. Crown projections onto the transect were used to obtain cover data for shrubs and trees by means of a straight iron rod suspended freely, and so vertically, from a point adjacent to the edge of the crown immediately over the steel tape.

As with the estimates of relative abundance, the percentages given below must be regarded as only rough and ready estimates of cover owing to the inadequacy of sampling. The sample was too small to make it worth while to calculate standard errors. The mean percentage cover, including the old potato and maize lands is 16.9 per cent all told, of which only 8.7 per cent is contributed by ground cover (basal area).

The high cover estimates of 3.23 per cent and 1.17 per cent for the trees *Nuxia congesta* and *N. floribunda* respectively are suspect. These estimates are derived from crown-projection intercepts and seem to be positively biased owing to the sample size being inadequate for any accurate assessment of tree cover, combined with a tendency for the use of crown-area rather than basal-area criteria to favour the chances of

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* As reported in Cain and Castro (1959): Evans and Cain also used steel tape.

mersonii	G	33.69	2.71	100	Commelin[illegible]?. C. diffusa	G	0.19	0.01	10
odoratissimum		13.98	1.20	30	Hypericum aethiopicum subsp.		0.19	0.01	10
plex	G	10.39	0.85	85	Jungermanniales ? †		0.19	0.02	5
iculata	G	5.53	0.52	60	Nuxia congesta		0.19	P 3.23*	5
uilinum		3.20	0.17	70	Smilax kraussiana		0.19	0.01	5
natalense var.		3.11	0.17	60	Tephrosia macropoda		0.19	0.02	5
urvula	G	2.82	0.34	50	Seedlings: Aeschynomene sp.?,cf. A. rehmannii var.?		0.10	+	5
yramidalis	G	2.43	0.25	50	Aspilia africana		0.10	+	5
o-paniculata	G	2.14	0.32	10	Cassinia phylicaefolia		0.10	+	5
acemosa	G	1.75	0.16	30	Cladonia sp. (Scheepers 1175)† (Lichen)		0.10	0.07	5
runelloides		1.75	0.09	30	Clutia affinis		0.10	+	5
celata	G	1.75	0.10	25	Cucumis sp.		0.10	+	5
ceresiiforme	G	1.65	0.17	25	Cynodon dactylon	G	0.10	+	5
ilifolius	G	1.46	0.14	20	Eriospermum cooperi		0.10	+	5
volutum		1.36	P 1.96*	15	Eucomis undulata		0.10	+	5
m repens	G	1.26	0.12	10	Fissidens papillifolius (Moss)		0.10	0.04	5
alidus	G	1.17	0.16	25	Gerbera piloselloides		0.10	+	5
ed, mostly crustose)†		0.68	0.55	5	Gladiolus woodii	G	0.10	+	5
adscendens†		0.68	0.08	5	Hebenstreitia comosa		0.10	+	5
		0.68	0.04	15	Helichrysum acutatum		0.10	0.02	5
striatus	G	0.58	0.03	5	H. fulgidum var. †		0.10	0.02	5
chrysargyrum†		0.49	0.07	5	H. umbraculigerum		0.10	+	5
n semiberbe	G	0.39	0.03	5	Hypoxis angustifolia	G	0.10	+	5
iflora	G	0.39	0.02	15	Mohria caffrorum		0.10	0.01	5
ahamiana		0.39	P 0.43*	15	Nuxia floribunda		0.10	P 1.17*	5
yssinica		0.39	0.02	5	Panicum hymenochilum var.	G	0.10	+	5
., cf. C. africana ?	G	0.29	0.02	5	Paspalum urvillei	G	0.10	0.01	5
sp., cf. F. hispidula	G	0.29	0.04	5	Pellaea viridis		0.10	+	5
hirta	G	0.29	0.02	15	Rapanea melanophloeos		0.10	P 0.11*	5

large-crowned species being included in the sampling unit (Buell & Cantlon, 1950). Other crown-projection cover estimates appear to be more trustworthy.

Paspalum commersonii, Hypericum revolutum and Helichrysum odoratissimum are estimated to have cover values of 2.71, 1.96 and 1.20 per cent respectively. The remaining species each contribute less than 1 per cent cover to the area sampled (viz. 20,000 cm^2). In spite of the probable weighting of crown-projection estimates at the expense of basal-area estimates, the grasses and grass-like plants appear to contribute the bulk of the totality of cover in the glade as well as of ground cover. In fact, of the total ground-cover estimate of 8.7 per cent, 6.0 per cent (i.e. 69.5 per cent) is contributed by grasses and grass-like plants (indicated by the letter "G" in Table 21).

Frequency. A consideration of the frequency estimates suggests considerable heterogeneity. Only two species are estimated to have frequency values exceeding 80 per cent: Paspalum commersonii has a sample frequency of 100 per cent, while that of Loudetia simplex is 85 per cent. An analysis of variance of relative density of Paspalum commersonii between and within contours failed to disclose any significant variation between or within contours at 5 per cent fiducial limits. The generally low frequency values noted do, however, reveal the patchy dispersion of even the better-represented species (see Table 21).

(iii) Ecological Notes. Gregarious growth is a conspicuous feature of several species in this glade. Bracken (Pteridium aquilinum) frequently forms extensive, dense, almost pure stands owing to its typically vigorous vegetative spread (see Plate 57).

Although not reproducing vegetatively, Flemingia grahamiana and, to a lesser extent, Rhynchosia clivorum, and also Clutia affinis, Lippia javanica, Vernonia ampla and Hypericum revolutum show marked sociability in invading dense grassveld. Although these shrubby plants may have difficulty in becoming established in and competing with a dense cover of short grasses, they appear to thrive and multiply once the competition afforded by the dense grass cover is weakened and even eliminated through invasion by Pteridium aquilinum, Helichrysum odoratissimum (see below) and large-tufted Cymbopogon validus. The lower-growing grasses are shaded out by bracken and H. odoratissimum and on the extensive bare ground between these latter plants and the large-tufted grasses, shrubs and trees can more easily become established and eventually shade them out.

Buddleia salviifolia, Canthium huillense, Erica woodii (subsp. robusta?) and other species not sampled, as well as several species of

Plate 57. The important part played by vegetatively spreading stands of Pteridium aquilinum in thickening up originally short grassveld. The bracken is accompanied and followed by increasing quantities of Cymbopogon validus, Vernonia ampla, Hypericum revolutum and Lippia javanica.

Plate 58. Large-scale invasion of upper portion of glade by Flemingia grahamiana, Rhynchosia clivorum, Schistostephium heptalobum, Selago natalensis, Vernonia ampla, species of Helichrysum

Helichrysum, also grow gregariously especially on the more disturbed sites (cf. p. 33-4 and Plate 55, Appendix A).

The suffrutescent forb Helichrysum odoratissimum is actively invading large portions of hitherto apparently well-grassed areas, especially on the more mesic aspects of the middle and lower slopes, without the prior intervention of Pteridium aquilinum. Apart from being a hardy adaptable species of the moister sites and the higher-rainfall areas of the Mistbelt, the spreading bushy habit of H. odoratissimum gives it an added advantage in competition with grasses in that its sprawling to trailing stems can grow over and between the tufts of lower-growing grasses and, with further growth, shade them out. Helichrysum splendidum of similar though more woody habit does not seem to grow as vigorously as H. odoratissimum, although individual plants grow to a greater size (see Plate 59). To judge by the relative abundance of these species (H. splendidum was not sampled), H. odoratissimum is by far the more competitive plant. As with Pteridium aquilinum, H. odoratissimum is also able to promote invasion of more woody plants, by virtue of the extensive areas of otherwise bare ground that it shades and shelters. These bare patches serve as favourable centres for the establishment of shrubs and forest precursors, especially when the old clumps begin to lose vigour. Apart from the varying states of vigour and senescence mentioned for Pteridium aquilinum and Helichrysum odoratissimum, most species recorded appeared to be thriving, but in some samples dead and moribund tufts of pioneer grasses were noted, e.g. of Sporobolus pyramidalis in the bottom and top contours.

The further succession of the lower xeroclinal portion of the glade, i.e. mainly north of the watershed below contour C, has already been discussed under the Lower High Forest Zone (p.28-32, Appendix A). Higher upslope, the subsere increasingly resembles that of the Middle High Forest Zone the salient features of which are set out below.

North of the watershed above contour C, over the ecotone between the Lower and Middle High Forest Zones, the glade vegetation consists mostly of a rather short but rather tussocky sour grassveld composed largely of the following species:

Plate 59. Large sprawling specimen of Helichrysum splendidum in mountain sourveld glade, Rosendal.

Paspalum commersonii
Digitaria apiculata
Cymbopogon validus
Loudetia simplex
Conostomium natalense var.
Pteridium aquilinum
Rhynchelytrum repens
Eragrostis racemosa
E. curvula
Helichrysum odoratissimum
Kyllinga cylindrica
Eupatorium africanum
Helichrysum acutatum
H. setosum
Moraea sp., aff. M. spathulata
Selago elata
Setaria sphacelata

Sporobolus pyramidalis
Commelina sp., cf. C. diffusa
Cyanotis nodiflora
Cynodon dactylon
Cyperus albostriatus
Cyphia elata
Endostemon obtusifolius
Helichrysum panduratum
H. umbraculigerum
Hyparrhenia hirta
Hypoxis angustifolia
Nidorella auriculata
Sparmannia ricinocarpa
Stephania abyssinica
Dryopteris athamantica
Pellaea viridis
Pentanisia prunelloides

Bracken thickets are rather limited in extent except towards the watershed. Nevertheless, this portion of the glade gives the impression of imminent large-scale invasion and encroachment by subwoody and woody plants, of which the following list includes the more conspicuous:

Pteridium aquilinum
Flemingia grahamiana
Vernonia ampla
Lippia javanica
Clutia affinis
Canthium inerme
Hypericum revolutum
Nuxia congesta
N. floribunda
Rhus intermedia
Heteromorpha trifoliata
Rhynchosia clivorum
Rubus pinnatus
Vernonia corymbosa

Acacia ataxacantha
Pseudarthria hookeri
*Psidium guajava
Rhamnus prinoides
Sphedamnocarpus galphimiifolius
Combretum gueinzii
Maesa lanceolata
Parinari curatellifolia subsp.
Rhus chirindensis forma
Aphloia theiformis
Brachylaena transvaalensis
Cussonia spicata
Myrica pilulifera
Pittosporum viridiflorum

Except for the first five, most of the above-mentioned species are rather scattered in their distribution, although Hypericum revolutum and Rhynchosia clivorum also tend to grow gregariously in places especially along the western forest-margin. Also present are scattered small bush clumps of Nuxia floribunda, Brachylaena transvaalensis, Maesa lanceolata, Ficus capensis, N. congesta, Pittosporum viridiflorum and even Parinari curatellifolia subsp. mobola, surrounded by fringes of Flemingia grahamiana, Hypericum revolutum and, sometimes, Rhynchosia clivorum.

South of the watershed, the vegetation bears a more distinctly montane impress. While noticeable even below contour C, this montane aspect becomes more striking with increase in altitude. Between contours C (1365 m) and B (1395 m) to the south of the watershed, the veld becomes increasingly rank and scrubby upwards and southwards. This change in vegetation in space is presumed to roughly parallel the expected successional changes in the vegetation in time.

Above (west of) the heads of the steep kloofs (see p. 224-7), the vegetation is mainly a rank sourveld of Cymbopogon validus, Paspalum commersonii, Pteridium aquilinum, Digitaria apiculata, Loudetia simplex and Monocymbium ceresiiforme with much Helichrysum odoratissimum. Pteridium aquilinum and H. odoratissimum increase appreciably upwards while C. validus also increases somewhat at the expense of the other grasses. Farther upslope, P. aquilinum and Flemingia grahamiana tend to replace the other species, sometimes forming dense thickets, more especially upwards. Higher up, particularly away from the watershed, Hypericum revolutum becomes increasingly important. Still farther upslope, the sourveld is in an advanced stage of encroachment by H. revolutum and a few other shrubs and the usual pioneer trees, e.g. Nuxia spp. and Rapanea melanophloeos.

Immediately below the old crop-lands through which contour B runs, lies a scrubby strip. The more conspicuous species in this strip, especially southwards, are listed below:

Hypericum revolutum	Pittosporum viridiflorum
Pteridium aquilinum	Rhus intermedia
Buddleia salviifolia (southern margins)	Sphedamnocarpus galphimiifolius
Smilax kraussiana	Rhamnus prinoides
Nuxia floribunda	Canthium huillense
Rapanea melanophloeos	Myrica pilulifera
Maesa lanceolata	Brachylaena transvaalensis
Nuxia congesta	Canthium gueinzii
Rubus pinnatus	Cussonia spicata
Aphloia theiformis	Stephania abyssinica
Curtisia dentata	Syzygium cordatum
Euclea crispa	Iboza riparia (occasional)

This scrubby vegetation is soon likely to thicken up into some type of seral montane scrub forest as exemplified by the Aphloia theiformis - dominated community described below:

(b) Aphloia theiformis Consocies (and Aphloia theiformis - Other Species Associes). A short distance south of the base point of the pegged-out contour B (1395 m elevation) a rather low and scrubby forest type of vegetation occupies the upper portion of the highest kloof of the Madikeleni Catchment. The fringing vegetation merges into the surrounding scrubby grassveld and the boundary is seldom clear-cut.

(i) Structure and Composition. The canopy is irregularly open to closed over the actual kloof, where it is also very uneven in height. The trees are irregularly spaced throughout. Stratification is poorly developed and only four or, at most, five synusiae can be easily recognised at any one place as a rule. All told, however, the following synusiae are represented:

"Canopy" or Tree Layer. The tree layer is here typically dominated by the large subscandent shrub or small tree Aphloia theiformis. Maesa lanceolata is subdominant, accompanied by the subscandent shrubby Rhamnus prinoides, together with Curtisia dentata, Pittosporum viridiflorum, Rapanea melanophloeos, Trimeria grandifolia, Dombeya burgessiae, Psychotria capensis, Rhus intermedia, Euclea crispa and, occasionally, exceptionally large specimens of Maytenus mossambicensis var. mossambicensis.

Shrub Layer. Transgressive trees tend to predominate in this stratum. Of these Rapanea melanophloeos is most prominent, accompanied by Fagara davyi, Psychotria capensis, Syzygium gerrardii and Trimeria grandifolia, together with occasional Curtisia dentata and Syzygium cordatum (especially in the kloof "bottom").

True shrubs are poorly represented. Among the more abundant is Canthium inerme with occasional Hypericum revolutum (where the canopy is open), Maytenus mossambicensis var. mossambicensis, Peddiea africana and Vernonia ampla, with Myrsine africana near the margin.

Field Layer.

Low Soft Shrubs, Undershrubs and Tall Herbs and Ferns. Dominating this sublayer is the sprawling and scrambling undershrub Cineraria fruticetorum accompanied by Stachys grandifolia, Senecio pandurifolius and Pavonia columella, together with the robust grass Hyparrhenia cymbaria, which often scrambles to considerable heights where the canopy is more open and along parts of the margin. Other undershrubs present are Desmodium repandum, Argyrolobium tomentosum and Sparmannia ricinocarpa. Along the margin, Pteridium aquilinum is especially conspicuous, accompanied by Schistostephium heptalobum, Senecio junodii, Nidorella auriculata, Tephrosia shiluwanensis and Phyllanthus nummulariaefolius.

Low Soft Herbs and Ferns. Dominating this sublayer and also the field stratum as a whole is Oplismenus hirtellus, with Carex spicato-paniculata subdominant, accompanied by Dryopteris inaequalis, Galopina circaeoides, Achyranthes aspera (forest form), Cyperus albostriatus and Pellaea viridis, with occasional Chlorophytum comosum and, very occasionally, Mariscus congestus and Selaginella kraussiana in the kloof "bottom".

Lianoid Plants. Climbers and scramblers are well represented. Although the canopy is low, irregular in height and discontinuous, the lianoid plants still fall into more or less distinct synusiae, divisible to some extent on the basis of a combination of size and woodiness rather than on whether or not they contribute to the canopy. They are accordingly subdivided here as follows:

Lianes and Scramblers. Smilax kraussiana is the dominant climber. Others of the more numerous, larger, and more woody lianoid plants are Choristylis rhamnoides, Secamone alpinii, Senecio tamoides, Sphedamnocarpus galphimiifolius, Asparagus falcatus, Rhynchosia caribaea, Rhoicissus rhomboidea, R. tridentata, Secamone gerrardii, Cephalanthus natalensis and Rhoicissus tomentosa.

Soft, Slender Twiners. The more abundant soft slender twiners include Asparagus asparagoides, Behnia reticulata and Riocreuxia picta with Asparagus plumosus and Dumasia villosa.

Hemiparasitic, Hemi-Epiphytic Twiners. Cassytha ciliolata is present but plays a very minor rôle compared with its participation in the scrub formation at lower elevations.

(ii) Ecological Notes. Among the most abundantly reproducing species are the following trees and shrubs:

Psychotria capensis	Allophylus transvaalensis
Rapanea melanophloeos	Aphloia theiformis
Canthium inerme	Apodytes dimidiata
Fagara davyi	Choristylis rhamnoides
Maytenus mossambicensis var.	Cryptocarya liebertiana
Curtisia dentata	Cussonia spicata
Pittosporum viridiflorum	Euclea crispa
Trimeria grandifolia	Syzygium gerrardii
Myrsine africana (especially near margin)	Heteromorpha trifoliata
Syzygium cordatum	Rhus intermedia

Appearances suggest that this Aphloia theiformis Consocies is rapidly changing by way of an A. theiformis - Other Species Associes into a taller more mixed community. Canopy trees of such a mixed community will probably include Aphloia theiformis, Rapanea melanophloeos, Curtisia dentata, Fagara davyi, Pittosporum viridiflorum, Syzygium cordatum, Apodytes dimidiata, Cryptocarya liebertiana, Cussonia spicata and Syzygium gerrardii. Woody plants of the understory and subordinate strata would probably include Canthium inerme, Psychotria capensis, the lianoid Choristylis rhamnoides, Maytenus mossambicensis var. mossambicensis, *Trimeria grandifolia*, *Rhamnus prinoides* (subscandent), *Allophylus transvaalensis* and *Peddiea africana*.

Such a mixed community is evidently likely to be an intermediate stage of short duration and, if protected, it will presumably eventually be succeeded by a mesic climax high forest intermediate between the climax high forests of the Middle High Forest Zone and those of the Upper High Forest Zone (cf. p. 234-6). The foregoing seral stage will apparently give rise to this climax high forest by the increase and invasion of the following trees which presumably remain to contribute substantially to the canopy of the climax community.

Canopy trees will probably include:

Rapanea melanophloeos
Cryptocarya liebertiana
Curtisia dentata
Cussonia spicata
Fagara davyi
Nuxia floribunda
N. congesta
Pittosporum viridiflorum (at first)
possibly *Syzygium cordatum* (in kloof?)
S. gerrardii

Apodytes dimidiata
Brachylaena transvaalensis
Combretum kraussii
Croton sylvaticus
Ficus craterostoma
Olea capensis subsp.
Prunus africana
Rhus chirindensis forma
Scolopia zeyheri
Trichilia dregeana
Xymalos monospora

In addition to *Xymalos monospora*, the later-stage understory trees and shrubs are likely to include *Canthium inerme*, *Psychotria capensis*, *Maytenus mossambicensis* var. *mossambicensis*, *Trimeria grandifolia* and, possibly *Allophylus transvaalensis*, *Diospyros whyteana*, *Ochna holstii*, *O. o'connorii*, *Peddiea africana*, *Rinorea angustifolia*, *Sclerochiton harveyanus*, *Teclea natalensis*, *Tricalysia capensis* and *Cassipourea gerrardii*. Among the more robust lianoid plants, *Asparagus falcatus*, *Canthium gueinzii*, *Rhoicissus rhomboidea*, *R. tomentosa*, *Secamone alpinii* and *S. gerrardii* can be expected, accompanied by a number of the slender twiners *Behnia reticulata* and *Tylophora flanaganii*.

(2) *Secondary Communities on Much-Disturbed Summit Sites*. Contiguous different stages of this secondary succession are present on the summit knoll of Piesang Kop. The whole site was formerly much disturbed by burning by Bantu and by grazing and trampling by their stock. Since the forties, at least, the vegetation has been protected from fire except for the firebreak along the boundaries between Pisangkop and Christinasrust, and between the Westfalia Estate portion and the remainder of Christinasrust. The firebreak provides an example of the state of the vegetation under conditions of extreme disturbance, viz. annual slashing, clearing and burning, while adjacent areas furnish examples of different stages of regeneration from which successional tendencies have been inferred.

The localities occupied by the seral stages described below are situated in the vicinity of the summit cairn of Piesang Kop at an altitude of approximately 1450 m, i.e. close to the boundary between the Middle High Forest Zone and the Upper High Forest Zone. In fact, this site, with its nearby Leucosidea sericea-dominated communities, could even be placed in the latter zone. Such an apparent local depression of the vegetation zones may, perhaps, be attributable to "Massenerhebung" effects on this more or less isolated feature (see p.50, cf. also p.88). The vegetation is more or less exposed to full sunshine at all times and to wind from all directions. The incidence of foggy weather is high and this immediate vicinity is quite often under cloud. Rainfall is probably quite heavy but very variable in distribution and intensity at different times and over short distances. The incidence of mist and heavy precipitation is probably offset to a large extent by long periods of exposure to intense sunshine and desiccating winds.

(2.1) Present Plagioseral Vegetation. It is rather surprising to note that many of the constituent species of the firebreak are components of the aestival and autumnal aspect socies rather than the vernal aspect socies. The following list includes the more prominent species of this fire-retarded community:

Anthospermum herbaceum
Conostomium natalense var.
*Erigeron floribundus
Hebenstreitia comosa
Hyparrhenia cymbaria
Indigofera schinzii
Pteridium aquilinum
Rhoicissus tridentata
Rhynchosia caribaea
Senecio pandurifolius
S. junodii
Setaria flabellata
S. sphacelata
*Tagetes minuta
Vernonia corymbosa
Artemisia afra
Aster peglerae
Athanasia punctata
Chenopodium schraderianum
Cineraria fruticetorum
Commelina ecklonii
Convolvulus farinosus
Crotalaria natalitia
Cyphia elata
Digitaria ternata
Eragrostis curvula
Flemingia grahamiana
Harveya coccinea
Leonotis dysophylla
Nidorella auriculata
Pavonia columella
Pelargonium alchemilloides
Plectranthus calycinus
Polygala virgata
Pseudarthria hookeri
Schistostephium heptalobum
Silene capensis
Sporobolus pyramidalis
Tephrosia shiluwanensis
Vernonia shirensis
Wahlenbergia banksiana
W. madagascariensis
W. undulata

(2.2) Subseres Developed on Former Plagioseral and Plagioclimax Sites. It seems reasonable to assume that, were disturbance of the fire-break to cease, the succession would tend in the direction of the adjacent undisturbed regenerating grassveld described below:

(a) Hyparrhenia cymbaria Consocies and Hyparrhenia cymbaria - Other Species Associes. The heterogeneous assemblage of vegetation which can be considered under the above heads is generally a scrubby sour grassveld with fairly frequently, though rather irregularly, scattered shrubs and small trees. The more homogeneous H. cymbaria Consocies is discussed first.

The vegetation is clearly dominated by the grass Hyparrhenia cymbaria, up to 2 m and more tall, accompanied by occasional subwoody herbaceous plants such as Clutia affinis, Schistostephium heptalobum, Athanasia punctata, Artemisia afra and sporadic fronds of Pteridium aquilinum. Occasional associated shrubs are Vernonia ampla, V. corymbosa, Lippia javanica, Lantana mearnsii and Grewia occidentalis. Acacia ataxacantha is the most numerous small tree, associated with A. davyi and accompanied by Rhus intermedia, Cussonia spicata, R. transvaalensis, Maytenus heterophylla, Euclea crispa, Heteromorpha trifoliata, R. chirindensis forma legatii and Maesa lanceolata, with occasional Brachylaena transvaalensis, Combretum kraussi and Ficus capensis. Also present are the lianoid plants Rhynchosia caribaea, Sphedamnocarpus galphimiifolius and Clematis brachiata among others.*

A variant of the Hyparrhenia cymbaria Consocies is found on the slight southerly slopes south of the Pisangkop-Christinasrust boundary firebreak. This is a scrubby sour grassveld with irregularly scattered trees. The herbaceous layer as well as the community as a whole is very clearly dominated by H. cymbaria, to 2 m and more tall, accompanied by occasional subwoody subshrubby plants such as Leonotis dysophylla and Polygala virgata. Associated shrubs include Vernonia ampla, Lippia javanica and occasional Canthium huillense. Among the more numerous trees invading the grassveld are Euclea crispa with Acacia ataxacantha, A. davyi, Heteromorpha trifoliata, Maesa lanceolata, Rhus intermedia, R. transvaalensis and Combretum kraussii, with occasional Apodytes dimidiata, Curtisia dentata, Faurea speciosa (especially to the west), Halleria lucida, Maytenus heterophylla, Pittosporum viridiflorum and Rhus chirindensis forma legatii. Lianoid plants present include Sphedamnocarpus galphimiifolius, Rhynchosia caribaea, Smilax kraussiana and occasional Canthium gueinzii.

It seems likely that these shrubs, trees and lianoid plants will close up, possibly with the influx of Leucosidea sericea from the east, to give rise to mixed scrubby vegetation that changes gradually in composition from north to south and west to east. Some indications

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* Lower downslope to the north, this community grades into the Secondary Acacia ataxacantha Consocies of the Lower High Forest Zone

Plate 60. Marginal Leucosidea sericea scrub north of the summit of Piesang Kop, Christinasrust, showing L. sericea, Pittosporum viridiflorum, Rubus pinnatus, Senecio deltoideus and Vernonia ampla.

Plate 61. Foreground: transitional Acacia ataxacantha scrub a short distance below the Leucosidea sericea scrub illustrated above. Background: A. ataxacantha scrub, upper xeroclinal slopes of

of possible courses of succession transitional to the Upper High Forest Zone are provided by the nearby scrubby types of vegetation in which Leucosidea sericea is dominant or codominant. These merge gradually into the more typical Middle High Forest Zone scrub types characterised by Euclea crispa, Pittosporum viridiflorum and others on the mesocline (Pisangkop), and of Acacia ataxacantha, A. davyi, Canthium huillense, Faurea speciosa and others (see p.48-51 and p.22-6 , Appendix A) on the xeroclines (Christinasrust). While the Westfalia Estate portion of Christinasrust does not show these intermediate types of vegetation, the remainder of Christinasrust demonstrates these transitions over a relatively short distance (see Plates 60 & 61). This strengthens the view that the summit knoll of Piesang Kop reaches the ecotone between the Middle and Upper High Forest Zones and that the summit portions, especially the xeroclines, of Piesang Kop are characterised by steep environmental gradients coinciding with the ecotones between the Lower, Middle and Upper High Forest Zones. The more typical and transitional subseral scrubby vegetation is described below:

(b) Euclea crispa Consocies. The community described here is located on the uppermost southwestern slopes of Piesang Kop near to the summit cairn at an altitude of about 1425 m.

(i) Habitat. The gradient varies from nearly level near the summit down to about 15° to 20° from the horizontal, the aspect varying from southwest to west-southwest. The sunny windy site receives a fairly heavy rainfall and mist but practically no run-off and erosion take place. The excellent infiltration is largely owing to the surface litter and duff and the dense growth of Hyparrhenia cymbaria. The soil is a very humiferous granular friable loam, which is sometimes rather sandy, with a deep layer of surface litter and duff.

The site was grazed and probably overgrazed by Bantu livestock until the thirties. The veld was also probably subject to periodic fires sweeping over the northern to northwestern slopes of Piesang Kop before the thirties and, perhaps, since then as well.

(ii) Structure and Composition. This stand varies from an open community near the summit to an uneven closed-canopy community lower down. The trees are irregularly but mostly widely spaced. Some three strata are well developed although they are not readily distinguishable owing to the wealth of lianoid plants. The following synusiae can be discerned:

"Tree Layer" (over about 3 m in height). This "layer" is clearly dominated by *Euclea crispa*, accompanied by *Pittosporum viridiflorum*, *Apodytes dimidiata*, *Combretum kraussii*, *Heteromorpha trifoliata*, *Rhus intermedia* and *R. transvaalensis*.

Shrub Layer (from about 1.5 m to 2.5 m in height). More abundant than the true shrubs in this stratum are transgressive *Euclea crispa* and *Pittosporum viridiflorum*, accompanied by transgressive *Apodytes dimidiata*, *Rhus transvaalensis*, *Maytenus heterophylla*, *Rhus intermedia* and *Trimeria grandifolia*, with occasional *Acacia ataxacantha*, *Canthium inerme*, *Combretum kraussii* and *Heteromorpha trifoliata*.

The most numerous shrubby plants are *Vernonia corymbosa* and *Clutia affinis*, associated with *Lippia javanica* and *Lantana mearnsii*, together with occasional *Maytenus mossambicensis* var. *mossambicensis* and *Vernonia ampla* among others.

Field Layer (up to about 1.5 m in height). For convenient discussion, the field layer is subdivided into three sublayers on the bases of size, woodiness and growth form:

Low Soft Shrubs, Undershrubs and Taller and Subwoody Forbs and Ferns. The most abundant species of this sublayer are *Hypoestes aristata* and *Schistostephium heptalobum*. The more numerous associated plants include the following:

Anthospermum herbaceum	*Plectranthus calycinus*
Aster peglerae	*Senecio pandurifolius*
Sparmannia ricinocarpa	*Justicia cheiranthifolia*
Helichrysum nudifolium var.	*Tephrosia shiluwanensis*
Nidorella auriculata	*Athrixia phylicoides*
Senecio junodii	*Cassinia phylicaefolia*
Helichrysum umbraculigerum	*Cineraria fruticetorum*
Pteridium aquilinum	*Conostomium natalense* var.
Indigofera schinzii	*Tephrosia polystachya*
Athanasia punctata	*Pavonia columella* (more disturbed sites)
	Hebenstreitia comosa

Grasses and Grass-like Plants. The dominant species in numerical abundance and the most conspicuous plant of the field layer is the tall, robust grass *Hyparrhenia cymbaria*. Associated with it is the sedge *Carex spicato-paniculata*, accompanied by *Setaria sphacelata*, *Commelina eckloniana*, *Schoenoxiphium sparteum*, *Cymbogon validus*, *Cyperus albostriatus* and *Oplismenus hirtellus*, with occasional *Panicum* sp., cf. *P. aequinerve*.

Low Soft Forbs and Ferns. The subwoody *Helichrysum nudifolium* var. *quinquenerve* and *H. umbraculigerum* are, perhaps, better included in this sublayer. Smaller softer plants are very infrequent and include local aggregations of *Galopina circaeoides* in the lower portion of this community, abutting on Seral Montane Scrub Forest (p.202-4). *Pellaea viridis* is widely scattered together with occasional *Eucomis undulata* and *Pelargonium alchemilloides* to mention but a few.

Ground Layer. The ground layer is poorly developed, consisting of a few mosses in the better-lit spots between grass tufts.

Lianoid Plants. The dominant species among the larger and more woody climbers and scramblers are clearly *Smilax kraussiana* and *Sphedamnocarpus galphimiifolius*. These species are accompanied by *Rhoicissus tridentata* and *Choristylis rhamnoides* with occasional *Dalbergia armata*.

The softer slender climbers are rather poorly represented. The most numerous species are *Rhynchosia caribaea*, *Asparagus asparagoides*, *A. africana* forma (cf. Scheepers 1028), *Adenia digitata*, *Cyphostemma cirrhosum* subsp. *transvaalense*, with occasional *Littonia modesta*, *Riocreuxia picta* and *Trochomeria hookeri*.

Epiphytes. Only cryptogamic epiphytes appear to be present. Lichens, e.g. species of *Ramalina* and *Usnea*, predominate in the crowns and upper stems and branches of trees, while mosses, e.g. *Macromitrium tenue*, usually grow lower down on the trunks.

Parasitic Plants. The hemiparasitic hemi-epiphytic twiner *Cassytha ciliolata* is typically fairly frequent.

(iii) Ecological Notes. This site was apparently formerly occupied by a more or less open stand of grassveld (cf. *Hyparrhenia cymbaria* - dominated communities, p.47-8 *et seq.*, Appendix A) which has thickened up to form the present scrubby community. This community will presumably continue to thicken up to form a dense closed scrub or scrub forest comparable with the *Euclea crispa*-Other Species Associes of the Lower High Forest Zone (cf. p. 172-4). The canopy of such an expected closed-canopy scrub or scrub-forest community would probably be dominated initially by *Euclea crispa*. Associated trees which would presumably become increasingly important would include *Heteromorpha trifoliata*, *Pittosporum viridiflorum*, *Apodytes dimidiata*, Combretum kraussii, Rhus intermedia, R. chirindensis forma legatii, R. transvaalensis, Rapanea melanophloeos, Trimeria grandifolia and species of Nuxia.

While it is not inconceivable that the southerly variant of the Hyparrhenia cymbaria-dominated grassland (see p. 47, Appendix A) could develop into Leucosidea sericea-dominated communities like those nearby, there is no evidence of such a sequence in the form of extant intermediate developmental stages. Scrutiny of old aerial photographs, however, reveals that at least part of the area now occupied by Leucosidea sericea scrub and scrub forest was formerly the site of rank and apparently tall, disturbed and presumably fire-controlled grassveld. On these tenuous grounds, the following Leucosidea sericea communities are included under these subseral stages apparently derived from much-disturbed grassveld.

(c) Leucosidea sericea - Combretum kraussii - Halleria lucida Associes. This scrub or scrub forest community is found a short distance east of the highest point of the summit knoll of Piesang Kop, just south of the northern boundary of Pisangkop at approximately 1440 m elevation.

(i) Habitat. The aspect is somewhat southerly to easterly, the slope varying from gentle to moderate, mainly southerly. The relatively high precipitation is the more effective owing to the vegetation being possibly more exposed to mist and rather less exposed to the sun and desiccating winds than are the nearby previously described subseral communities. The microclimate is normally damp and cool to cold and seldom hot. The soil is usually moist except sometimes towards the end of a long dry season when the drier conditions are probably mitigated by fairly frequent foggy weather and cloud.

The soil forms a shallow, mostly very humiferous layer over granite-gneiss and a diabase dyke which crops out at the firebreak. The surface litter and duff are mostly fairly deep, except where disturbed near the firebreak. The undisturbed soil apparently has a high water-retaining capacity and there is practically no surface run-off even from heavy downpours. The extremely localised occurrence of this and the following community are probably to be correlated with the very localised occurrence of the cool moist conditions approximating conditions more typical of the Upper High Forest Zone.

(ii) Structure and Composition. The trees are rather irregularly spaced but with spreading crowns forming a more or less closed canopy. Stratification is poorly developed. Apart from the canopy and field layer, other strata may be recognised only with difficulty. Although some seven synusiae can be reckoned to be present, five of these are only poorly represented. Downslope, to the south, the community grades into more typical seral scrub of the Middle High Forest Zone (cf. *Euclea crispa* Consocies: p.48-51 , Appendix A); and Seral Montane Scrub Forest: p.202-4).

Canopy (3 m to 4 m or more in height: trees taller downslope). The tree stratum consists mainly of *Leucosidea sericea* (↑), *Combretum kraussii* and *Halleria lucida* (↑), with scattered *Brachylaena transvaalensis* (↓), *Cussonia spicata* (↓), *Dombeya burgessiae* and *Maesa lanceolata*.

Understory (2 m to 3 m in height). This layer is poorly developed consisting of scattered individuals of *Eugenia natalitia*, *Maytenus mossambicensis* var. *mossambicensis*, *Peddiea africana*, *Tricalysia capensis* and *Trimeria grandifolia*.

Shrub Layer. Shrubs proper (1 m to 2 m tall) are poorly represented, the only shrubs seen being *Carissa bispinosa* var. *acuminata* and *Vernonia ampla*, but transgressive trees are more numerous.

Field Layer (up to 1 m in height).

Low Soft Shrubs, Undershrubs and Tall Subwoody Herbs. This sublayer is dominated by *Hypoestes verticillaris*. Associated with it is *Desmodium repandum*, accompanied by occasional *Argyrolobium tomentosum*, *Asparagus virgatus*, *Schistostephium heptalobum* and *Sparmannia ricinocarpa*.

Low Herbs and Ferns. This sublayer is dominated by the grass *Oplismenus hirtellus* with *Dietes vegeta* locally abundant to subdominant, accompanied by an orchid (*Satyrium* sp.?), *Galopina circaeoides*, *Liparis neglecta* and *Cyperus albostriatus*, with occasional *Asplenium splendens*, *Dryopteris inaequalis* and *Haemanthus magnificus*.

The accumulation of litter seems to be inimical to the establishment of a ground layer.

Lianoid Plants. Scandent and subscandent plants are poorly represented in the upper marginal portion dominated by Leucosidea sericea where, however, several young plants may be seen. The latter include especially Canthium gueinzii together with Rhoicissus rhomboidea and, inter alia, occasional Asparagus asparagoides and Riocreuxia picta. The following include the more numerous fully grown lianoid plants at present:

Lianes and Scramblers. The more robust and woody lianoid plants reaching the canopy include Rhoicissus rhomboidea, Jasminum streptopus var. transvaalense, Choristylis rhamnoides and Secamone gerrardii with occasional Canthium gueinzii, Cryptolepis capensis, Cyphostemma anatomicum, Pyrenacantha grandiflora, Senecio tamoides and Smilax kraussiana.

Soft Slender Climbers. Apart from small specimens of Jasminum streptopus var. transvaalense and occasional immature Pyrenacantha grandiflora, this niche is scarcely filled. True components of this synusia are Asparagus asparagoides and Riocreuxia picta, with occasional Behnia reticulata.

Epiphytes. Despite the rough bark of Leucosidea sericea, this tree does not carry a rich epiphytic flora except for certain lichens, e.g. Lobaria pulmonaria and species of Usnea and Ramalina. The loose and easily shed rough bark may be unfavourable for the establishment of heavier epiphytes on old trees in this otherwise apparently favourable situation, but the possibility of inhibitory exudates in the bark cannot be ruled out. The only vascular epiphytes observed in any quantity in this mixed community were Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana with occasional Polystachya imbricata. P. transvaalensis and isolated seedlings and saplings of the hemi-epiphytic strangler, Ficus craterostoma.

(iii) Ecological Notes. A striking feature of this mixed community is the almost complete lack of reproduction by Leucosidea sericea even near the upper margin where L. sericea predominates. The more abundant seedlings and saplings of woody plants are those of the following species:

Pittosporum viridiflorum
Allophylus transvaalensis
Cryptocarya liebertiana
Canthium gueinzii (lianoid)
Maytenus mossambicensis var.
Euclea crispa
Choristylis rhamnoides (lianoid)
Clausena anisata
Cussonia spicata
Fagara davyi
Rhoicissus rhomboidea (lianoid)
Trimeria grandifolia
Bersama sp., cf. *B. transvaalensis*
Calpurnia aurea
Combretum kraussii
Ochna holstii
Peddiea africana

The mixed scrub and scrub forest vegetation immediately south of the summit of Piesang Kop can be regarded as representing progressive stages in the gradual succession to high forest. The succession seems to be slow because of the exposed situation. This stage will presumably thicken up with progressive increase, at the expense of *Leucosidea sericea*, of the following woody species:

Canopy

Cryptocarya liebertiana, *Pittosporum viridiflorum* (↑, especially towards the margin), *Combretum kraussii*, *Cussonia spicata*, *Euclea crispa* (especially towards the margins) and *Fagara davyi* with occasional *Apodytes dimidiata*, *Ficus craterostoma* and *Prunus africana* and, later, perhaps *Syzygium gerrardii* as well.

Subordinate Woody Plants

Allophylus transvaalensis
Maytenus mossambicensis var.
Clausena anisata
Eugenia natalitia
Trimeria grandifolia
Bersama sp., cf. *B. transvaalensis*
Calpurnia aurea
Carissa bispinosa var.
Dombeya burgessiae (especially margins)
Halleria lucida
Ochna holstii
Peddiea africana
Maesa lanceolata (margins)
Maytenus heterophylla (margins)
Rhus intermedia (margins)

Lianoid Plants

Canthium gueinzii, *Rhoicissus rhomboidea*, *Jasminum streptopus* var. *transvaalense*, *Choristylis rhamnoides* and *Secamone gerrardii*.

(d) Leucosidea sericea Consocies. The stand described here is found just over the boundary of Westfalia Estate in the southwestern corner of the remainder of Christinasrust on the summit knoll of Piesang Kop at an altitude of about 1450 m.

(i) Habitat. The site is very slightly sloping to roughly east-southeast. The microclimate is probably almost identical with that of the community previously described (p. 51 , Appendix A) except that this community is more exposed to the sun and desiccating winds. The soil is apparently also very similar to that of the community previously described but here it is shallower and rockier. The surface litter and duff are mostly fairly deep except where disturbed. There is evidence of sporadic grazing and trampling by livestock, chopping and removal of wood for fuel, poles and sticks. This disturbance continues at present.

(ii) Structure and Composition. The trees are fairly regularly spaced becoming more irregular as the Hyparrhenia cymbaria Associes of the summit (p.47-8 , Appendix A) is approached. Stratification is poorly developed. Although some six or seven synusiae are usually present within a small area, generally only some three or four of these are easily recognisable at a time. All told, the following synusiae are represented:

Canopy. The canopy is more or less closed but irregular in height varying from 3 m high, where lowest, to from 4 m to 5 m in height elsewhere. The canopy is very clearly dominated by Leucosidea sericea, with a small localised area on the transition to the Hyparrhenia cymbaria-dominated grassveld where Catha edulis predominates almost to the exclusion of other trees. This Catha edulis socies or colony may mark the site of abandoned cultivation as it sometimes does elsewhere but no concrete evidence of this was seen. Leucosidea sericea is accompanied here by small to medium-sized Acacia davyi (moribund relics of succession), Euclea crispa, Halleria lucida and Heteromorpha trifoliata with occasional Apodytes dimidiata, Combretum kraussii, Cussonia spicata, Kiggelaria africana, Pittosporum viridiflorum, Prunus africana and Trimeria grandifolia.

Understory (2 m to 3 m in height). An understory proper was not present in 1962, but an "understory" of potentially taller trees appeared to be developing. Such transgressive trees noted in this stratum were Euclea crispa, Xymalos monospora, Bersama sp., cf. B. transvaalensis and Ziziphus mucronata.

Shrub Layer (1 m to 2 m tall). Apart from occasional Carissa bispinosa var. acuminata, this layer is poorly developed as far as true shrubs are concerned. The virtual absence of understory and shrub layer may be due to the disturbance caused by browsing livestock, e.g. donkeys.

Field Layer (up to about 1 m in height). Probably owing to the browsing and trampling of livestock, the field layer is rather poor in species, which also include typical plants of disturbance. Nevertheless, it is still a convenient and natural treatment to consider the field layer as comprising two sublayers as follows:

Undershrubs, Tall Subwoody Herbs and Ferns. Argyrolobium tomentosum predominates locally over quite extensive areas. Others among the more abundant species of this sublayer are Desmodium repandum, Plectranthus laxiflorus, Sparmannia ricinocarpa, Cineraria fruticetorum and Schistostephium heptalobum with occasional Anthospermum herbaceum and Pteris catoptera.

Low Herbs and Ferns. Except under Argyrolobium tomentosum, the field layer is dominated over wide areas by Oplismenus hirtellus, accompanied by Galopina circaeoides, Liparis neglecta, Zantedeschia tropicalis, Haemanthus magnificus and Pellaea viridis.

Lianoid Plants. Climbing plants are poorly represented with regard to numbers, both of species and individuals. Those present fall, nevertheless, into two more or less distinct synusiae:

Lianes and Scramblers. Among the more robust and woody lianoid plants normally capable of reaching the canopy are Clematis brachiata, Secamone alpinii, Rhoicissus rhomboidea and Secamone gerrardii with occasional Asparagus falcatus, Mikania cordata and Sphedamnocarpus galphimiifolius.

Softer Slender Climbers. The few, less robust, soft lianoid plants normally incapable of reaching the canopy include Asparagus asparagoides and Senecio deltoideus with occasional Behnia reticulata, Oreosyce sp.? cf. O. subsericea? (Cucurbitaceae), Riocreuxia picta and Thunbergia alata.

Epiphytes. Epiphytic lichens, e.g. species of Usnea and Ramalina, are abundant in the upper crowns, especially on dead wood, where sufficient light prevails. Epiphytic mosses, e.g. Pilotrichella species, are occasionally met with lower down on trunks. Vascular epiphytes are rather few in number. The more abundant of these are Pleopeltis macrocarpa, Polypodium polypodioides subsp. ecklonii and Polystachya ottoniana, with occasional Asplenium rutaefolium. Leucosidea sericea has a rough scaly bark apparently favourable for the attachment of lichens in the crowns but the bark of older branches and trunks is loose and sloughs off.

(iii) Ecological Notes. As in the case of the Leucosidea sericea - Combretum kraussii - Halleria lucida Associes, there is little or no reproduction of L. sericea in evidence in the Leucosidea sericea Consocies. Notwithstanding the fact that the latter community is still disturbed, there is an appreciable measure of regeneration of other woody plants. If it were protected from disturbance, this Leucosidea sericea Consocies would presumably eventually be replaced by a more typical mixed scrub-forest community probably including the following woody species amongst others:

Canopy Trees:

Xymalos monospora, Catha edulis (? margins and disturbed sites), Apodytes dimidiata, Kiggelaria africana, Cussonia spicata, Combretum kraussii, Cryptocarya liebertiana, Prunus africana and Rhus chirindensis forma legatii and, perhaps, Syzygium gerrardii.

Subordinate Woody Plants:

Euclea crispa, Allophylus transvaalensis, Trimeria grandifolia, Peddiea africana, Rhamnus prinoides, Canthium inerme, Eugenia natalitia, Halleria lucida, Maytenus mossambicensis var. mossambicensis, Ochna holstii and Bersama sp., cf. B. transvaalensis, as well as numerous transgressive Xymalos monospora.

Lianoid Plants:

Clematis brachiata, Rhoicissus rhomboidea, Secamone alpinii, S. gerrardii, Canthium gueinzii and Grewia occidentalis.

APPENDIX B

CHECK-LIST

With the exception of the Pteridophyta (sensu Harder et al., 1962), the names and arrangement of the divisions and classes are in accordance with Harder et al. (1962). The classification of Nostoc follows Claassen (1961) and the Lichens are arranged after Zahlbruckner (1940). The few Hepaticae collected are classified after Arnell (1963). The arrangement of the Musci follows that of Sim (1926), the names having been checked, where possible, against the first three volumes of the Index Muscorum edited by Van der Wijk, Margadant and Florschutz (1959, 1962 & 1964). The arrangement of the fern-allies and ferns accords with the system employed by Alston (1959) and adopted by Schelpe (1964). Spermatophyte genera are arranged according to the system of De Dalla Torre and Harms (1906-1907) followed by Phillips (1951) and as used at the National Herbarium, Pretoria. The names of all species are arranged alphabetically within genera for convenience.

Besides conventional abbreviations, symbols, words and abbreviations are used in the following senses:

* Before a name, *	=	Introduced (in the sense of p. 45 et seq.)
a.	=	abundant
c.	=	common
f.	=	frequent
ff.	=	fairly frequent
L.S.B.	=	Lowveld Sour Bushveld
L.S.B.T.	=	Lowveld Sour Bushveld Transition Zone
N.E. Mtn. Sourveld	=	North-Eastern Mountain Sourveld
occ.	=	occasional/occasionally
rr.	=	rather rare
S	=	Scheepers
seepages	=	seepages and/or seepage areas
S K F	=	specimens collected in the course of the Smith, Klein and French alkaloid survey.
s.n.	=	sine numero (unnumbered collection)
s.n. (PRE)	=	Unnumbered collection kept at the National Herbarium, Pretoria
widespread	=	both Low Country and Mistbelt

CYANOPHYTA

NOSTOCACEAE

Nostoc sp., probably N. sphaericus Vaucher
Large gelatinous masses. On seepages on solid rock, L.S.B.T. S : 1149

LICHENES

STICTACEAE

Sticta aurata Ach.
Small yellow-green epiphytic foliose lichen, Mistbelt. S : s.n.

Lobaria pulmonaria (L.) Hoff.
Foliose epiphytic lichen. Mistbelt. Local. S : 986

CLADONIACEAE

Cladonia sp.
Fruticose lichen colonising very shallow soil in Mistbelt lithosere. S : 940

Cladonia sp.
Fruticose lichen colonising bare eroded soil in Mistbelt. S : 1175

PARMELIACEAE

Parmelia sp.
Foliose lichen. Pioneer: rock mat formation. Mistbelt mesocline. S : s.n.

USNEACEAE

Ramalina yemensis Nyl. var.
Epiphytic fruticose lichen; especially in Mistbelt. S : s.n.

Usnea sp.
Epiphytic fruticose lichen. Mistbelt. Infrequent to locally ff. S : 1163

CALOPLACACEAE

Caloplaca cinnabarina (Ach.) Zahlbr.
Crustose lichen. Localised to locally abundant pioneer on granite-gneiss sheet rock, xeroclinal rock mat formation, Mistbelt. S : s.n.

TELOSCHISTACEAE

Teloschistes sp.
Epiphytic fruticose lichen. Scattered in Mistbelt. S : s.n.

BUELLIACEAE

Buellia stellulata (Tayl.) Mudd.
Crustose lichen. Localised to locally ff. pioneer on granite-gneiss sheet rock, xeroclinal rock mat formation, Mistbelt. S : s.n.

Buellia sp.
Crustose lichen. Localised to locally ff. pioneer on granite-gneiss sheet rock, xeroclinal rock mat formation. Mistbelt. S : s.n.

PHYSCIACEAE

Anaptychia leucomelaena Wainio
Epiphytic fruticose lichen. Infrequent to locally ff. in Mistbelt. S : s.n. (PRE)

BRYOPHYTA

HEPATICAE

RICCIACEAE

Riccia fluitans L. (aquatic form)
Small half-floating liverwort in wet shaded spot. S : 659

MARCHANTIACEAE

Dumortiera hirsuta (Sw.) Nees
Liverwort of very wet and shady places. S : 984

Marchantia wilmsii Steph.
Widespread liverworts of shaded damp rock and bare soil banks. S : 562

GRIMALDIACEAE

Asterella species (= Fimbriaria species)
Small liverworts of very wet shady places. S : s.n.

ANTHOCEROTACEAE

Anthoceros species
Small thalloid hepatics on moist soil. Localised.

MUSCI

POLYTRICHACEAE

Pogonatum capense (Hampe) Jaeg.
Clothing bared earth banks especially in Mistbelt. S : 660

Polytrichum commune L.
Widespread but localised large moss, growing in colonies on bare earth and rock banks especially in Mistbelt. S : 942

DICRANACEAE

Ditrichum flexifolium (Hook.) Hampe
Small moss on moist bare earth, as on roadside banks especially in Mistbelt. S : 661

Leucoloma rehmannii (C.Muell.) Rehm.
Epiphyte forming dense mats, (especially on Syzygium gerrardii?). In Mistbelt high forest (especially with S. gerrardii dominant or codominant?) S : 209

Campylopus purpurascens Lorentz
Fair-sized moss growing gregariously on ground in Mistbelt. S : 1214

Campylopus sp.
Colonising mats of crustose lichens and bare rock, mesoclinal rock mat formation, Mistbelt. S : 1161

FISSIDENTACEAE

Fissidens papillifolius Dixon
Small moss on ground, N.E. Mtn. Sourveld. Very rare. S : 1211

GRIMMIACEAE

Ptychomitrium crispatum (Hook. et Grev.) W.P. Sch.
Small moss forming dense mats, mesoclinal lithosere, Mistbelt. S : 1118

P. eurybasis Dixon
Small mat-forming moss on rock outcrops. Mistbelt. S : 1215

TORTULACEAE

Hyophila atrovirens (C.Muell.) Jaeg.
Small mat-forming moss on shaded rock, Mistbelt. S : 1217

Tortella petrieana Sim
Forming loose mats on rock, mesoclinal rock mat formation especially in Mistbelt. S : 1224

ORTHOTRICHACEAE

Macromitrium tenue (Hook. et Grev.) Brid.
Epiphytic mat-forming moss in Mistbelt. S : 1218

Schlotheimia rufo-aeruginosa C.Muell.
Small epiphytic sp. forming dense mats. S : 1125

FUNARIACEAE

Funaria hygrometrica (L.) Sibth.
Hygrophytic moss. S : 897

BRYACEAE

Bruym argenteum Hedw. var. lanatum (P.Beauv.) Hampe
Small silvery moss. Epiphytic or on stones and ground. S : s.n.

Rhodobryum sp.
Very localised. On scrub forest floor, Mistbelt. S : 963

Rhodobryum sp. (= Scheepers 963?)
Localised to locally abundant, fairly large gregarious sp., forming extensive colonies, mesoclinal rock mat formation, Mistbelt. S : s.n.

HEDWIGIACEAE

Braunia secunda (Hook.) B.S.G.
Mat-forming. Colonising lichen mats in mesoclinal rock mat formation, Mistbelt. S : 1228

CRYPHAEAE

Cryphaea exigua (C.Muell.) Jaeg.
Epiphytic moss. Rare and localised, in Mistbelt. S : s.n.

LEUCODONTACEAE

Leucodon maritimus (Hook.) Wijk et Marg.[=L. assimilis (C.Muell.) Jaeg.]
Pioneer on bare rock and colonising lichen mats. Localised. Mesoclinal rock mat formation, Mistbelt. S : 1229

LESKEACEAE

Haplocladium angustifolium (Hampe et C.Muell.) Broth.
Mat-forming moss on rocks, especially in Mistbelt. S : 1210

NECKERACEAE

Squamidium sp.
Localised epiphytic sp., Mistbelt. S : s.n.

Papillaria africana (C.Muell.) Jaeg.
Pioneer forming loose mats on bare rock and colonising lichen mats, mesoclinal rock mat formation, Mistbelt. Localised. S : 1226

Pilotrichella chrysoneura (Hampe) Jaeg.
Epiphytic. Long hanging stems festoon forest trees. Localised to locally abundant in high forest and gallery forest, in Mistbelt. S : 1230

P. panduraefolia (C.Muell.) Jaeg.
Epiphytic. Long pendulous stems on forest tree stems. Localised to locally abundant in high forest and gallery forest, in Mistbelt. S : 1220

Neckera valentiniana Besch.
Large leafy pendulous epiphytic moss in extensive mats. In Mistbelt. S : 1121

Porothamnium comorense (Hampe) Sim
Fairly large erect or suberect sparsely growing moss on stones and bark. Mistbelt. S : 1231

ENTODONTACEAE

Trachyphyllum gastrodes (Welw. et Duby) Gepp.
Pioneer on bare rock, forming dense mats. Mesoclinal rock mat formation, Mistbelt. S : 1227

Erythrodontium abruptum (C.H.W.) Broth.
Clothing bark of Adina microcephala var., gallery forest.
First record for South Africa. S : 1222

Levierella fabroniacea C.Muell. var. abyssinica (Broth.) Dixon
Moss forming dense mats on shaded rocks, Mistbelt. S : 1216

Entodon brevirameus Dixon
Epiphytic and on rocks under light shade. S : 444

E. dregeanus (Horns) C.Muell.
Epiphytic and on rocks and soil surface, bright light to light shade. S : 1212

HYPNACEAE

Mittenothamnium pseudoreptans (C.Muell.) Card.
Forming dense mat on rock in Mistbelt. Localised. S : 1225

SEMATOPHYLLACEAE

Sematophyllum brachycarpum (Hampe) Broth.
On granite-gneiss along Ramadiepa River, L.S.B.T. S : 1223

RHACOPILACEAE

Rhacopilum capense C.Muell.
Low-growing sp., forming mat on shaded rock, lower edge of Mistbelt. Localised. S : 1219

(PTERIDOPHYTA)

LYCOPSIDA

LYCOPODIACEAE

Lycopodium cernuum L.
Widespread sp., but localised to locally common on moist banks.
Low Country. S : 743

L. clavatum L.
Trailing. Widespread but localised. Extensive colonies locally in Mistbelt. S : 657

SELAGINELLACEAE

Selaginella dregei (Presl) Hieron.
Small mat-forming pioneer of depressions, rock mat formation. Widespread but localised: lithoseres of Low Country and Mistbelt. S : 1119

S. kraussiana (Kunze) A.Br.
Prostrately spreading moss-like sp. Localised to locally ff. on forest floor especially gallery forest near water. S : 1002

S. mittenii Bak.
Low prostrately spreading moss-like sp. Very localised. Infrequent on rocky banks of streams. Mistbelt and Low Country. S : 929

PTEROPSIDA

OPHIOGLOSSACEAE

Ophioglossum reticulatum L.
Small perennial herbaceous plant of disturbed open sites. Very localised, occ. Locally ff. in Low Country. S : 1124

MARATTIACEAE

Marattia fraxinea Smith ex Gmel. var. salicifolia (Schrad.) C.Chr.
Large stout-stemmed fern of stream banks, riverine forest. S : 71

OSMUNDACEAE

Osmunda regalis L.
Fairly large ferns with short stumpy stems. Waterside of streams and rivers especially where shaded. S : 350

GLEICHENIACEAE

Dicranopteris linearis (Burm.f.) Underw.
Rr. scrambler on disturbed bare earth banks. S : 1009

SCHIZAEACEAE

Schizaea pectinata (L.) Sw.
Rather grass-like rosette of fronds from rootstock. Very localised and infrequent, gregarious, here in lithoseral grassveld, Mistbelt.
S : 1147

Mohria caffrorum (L.) Desv.
Rosette fern. Especially on steep banks, retarded grassveld in Mistbelt. Locally ff. to c. S : 383

MARSILEACEAE

Marsilea macrocarpa (DC.) Presl
Introduced? Very localised in grass sward. Rare. S : 9

CYATHEACEAE

Cyathea dregei Kunze
Fair-sized tree fern. Mistbelt, and gallery forest and other moist places in Low Country. S : 100,443

HYMENOPHYLLACEAE

Trichomanes pyxidiferum L. var. melanotrichum (Schlechtdl.) Schelpe
Small filmy fern clothing wet rocks, bark etc. Localised, infrequently scattered to locally numerous in wet, shady cool parts of high forest and kloof forest, Mistbelt. S : 615

DENNSTAEDTIACEAE

Hypolepis sparsisora (Schrad.) Kuhn
Localised. Large bracken-like fern of openings in upper high forest and forested Mistbelt kloofs. S : 421

Pteridium aquilinum (L.) Kuhn
Fern with variable-sized fronds (to 2 or 3 m) from underground rootstock. Widespread to locally ff. to abundant in disturbed retarded grassveld and scrub, and important in succession, especially in Mistbelt. S : 197,669

ADIANTACEAE

Adiantum thalictroides Willd.
Small creeping fern. Very localised on steep slopes in Mistbelt. S : 948

Pteris catoptera Kunze
Rosettes of large fronds. Rather localised to ff. in undergrowth of high forest and gallery forest near water. S : 418

P. cretica L.
Rosette of fronds from rootstocks. Very localised. Shaded, damp and cool situations in kloofs. Very infrequent. S : 596

P. vittata L.
Rosettes of fairly long fronds from rootstocks. Very localised. Moist crevices in rock banks and retaining walls of streams and canals. Locally ff. S : 1092

Cheilanthes bergiana Schlechtdl.ex Kunze
Very localised. Disturbed shady places, e.g. footpaths, in Mistbelt forest. S : 1192

C. hirta Sw.
Localised variable sp. In shallow humiferous soil on rocky ledges in open riverine forest and scrub forest, Mistbelt. A contracted form is locally ff. in disturbed, retarded rocky N.E.Mtn. Sourveld. S : 434,1080

Notholaena eckloniana Kunze
Rosettes in dense tufts. Localised chasmophyte of xeroclinal lithosere, Mistbelt. Infrequent. S : 1136

Doryopteris concolor (Langsd. et Fisch.) Kuhn var. kirkii (Hook.) Fries
Very localised fern of moist shady places. S : 549

Pellaea calomelanos (Sw.) Link.
Rosette fern. Rather localised. Especially in rock crevices, Mistbelt lithosere S : 855

P. dura (Willd.) Baker
Small rosette fern. Very localised. In crevices, L.S.B.T. lithosere. S : s.n.

P. quadripinnata (Forsk.) Prantl
Fairly large rosette fern. Locally ff., especially in Mistbelt, mesoclinal lithoseral grassveld. S : 431

P. viridis (Forsk.) Prantl
Widespread, very variable rosette fern in grassveld, scrub, scrub forest and plantations. S : 35

POLYPODIACEAE

Pleopeltis excavata (Bory ex Willd.) Moore
Creeping epiphytic fern of high forest. Localised, Mistbelt. S : 881

P. macrocarpa (Bory ex Willd.) Kaulf.
Creeping epiphytic fern of gallery forest, high forest, scrub forest and scrub, especially in Mistbelt. Rather localised to locally ff. S : 66

Polypodium polypodioides (L.) Hitch. subsp. ecklonii (Kunze) Schelpe
Creeping epiphytic fern of gallery forest, high forest, scrub forest and scrub, especially in Mistbelt. Rather localised to locally ff. S : 807

ASPLENIACEAE

Asplenium aethiopicum (Burm) Becherer
Epiphytic or ground fern of variable size. S : 67,650

A. anisophyllum Kunze
Robust epiphytic fern in moist high forest. S : 600

A. erectum Bory forma
On ground, seldom epiphytic. Underground in high forest. S : 477

A. flexuosum Schrad.
According to Schelpe (in lit.): Putative hybrid between A. gemmiferum Schrad. and A. rutaefolium (Berg) Kunze. Growing together with the suspected parent species. S : 673

A. gemmiferum Schrad.
Epiphytic or in humus on rocks and boulders in moist high forest sites, especially riverine forest. S : 415

A. inaequaelaterale Hieron.
In humus on rock and boulders in moist high forest, especially riverine forest. S : 416

A. lobatum Pappe et Rawson
On ground, seldom epiphytic. Undergrowth in high forest. S : 446

A. rutaefolium (Berg) Kunze
Frequent epiphyte in high forest. S : 102

A. sandersonii Hook.
Small epiphytic fern of moist high forest sites, especially riverine forest. S : 104

A. splendens Kunze
Epiphytic or ground fern of variable size. Widespread but rather localised. Very infrequent. S : 156,646

THELYPTERIDACEAE

Thelypteris bergiana (Schlechtdl.) Ching
Rosette fern. Widespread but rather localised to locally ff. to abundant along shady stream banks. S : 238

T. madagascariensis (Fée) Schelpe [= Cyclosorus madagascariensis (Fée) Ching] [=Dryopteris sylvatica (Pappe et Rawson) C.Chr.]
Fronds in rosettes. Widespread but rather localised. Locally ff. to abundant along shady stream banks. S : 406

T. palustris Schott var. squamigera (Schlechtdl.) Tard.
Fronds scattered along slender rhizome. Widespread but localised to locally ff. to dominant and subdominant in early stages of hydrosere. S : 226

T. pozoi (Lagasca) Morton
Rare and localised. In high forest (especially riverine). S : s.n.

T. totta (Thunb.) Schelpe [= Cyclosorus gongylodes (Schkuhr) O.Ktze.]
Fronds scattered along slender rhizome. Localised to locally dominant and subdominant in early stages of hydrosere. Low Country. S : 133

ATHYRIACEAE

Athyrium scandicinum (Willd.) Presl
Variable-sized fern. Localised to occ. ff. Moist places in gallery and riverine forest. S : 420

LOMARIOPSIDACEAE

Elaphoglossum acrostichoides (Hook. et Grev.) Schelpe
Robust epiphyte. Very localised but locally abundant. In Mistbelt high forest, especially riverine. S : 890

ASPIDIACEAE

Dryopteris athamantica (Kunze) O.Ktze.
Erect fronds in rosettes. Rather localised here. Infrequent to locally gregarious. Especially in N.E. Mtn. Sourveld. S : 577

D. inaequalis (Schlechtdl.) O.Ktze.
Widespread, robust rosette fern. Rather infrequent to occ. locally ff., especially in mesophytic scrubby vegetation. S : 101,555

Arachniodes foliosa (C.Chr.) Schelpe (MS.) [= Dryopteris foliosa C.Chr.]
Few fronds in rosette. Rr. to infrequent in riverine forest. S : 456

Polystichum ammifolium (Poir.) C.Chr.
Rosette fern of moist shady places in Mistbelt forests. Localised in infrequent aggregations of few individual plants. S : 419

Ctenitis lanuginosa (Willd. ex Kaulf.) Copel.
Rosettes of large fronds. Rr. to infrequent. Near water in open kloof forest, Mistbelt. S : 436

Tectaria gemmifera (Fée) Alston
Variable-sized fern with large rootstock. Fairly widespread but rather localised to occ. locally ff. Gallery forest and moister parts of high forest. S : 258

BLECHNACEAE

Blechnum attenuatum (Sw.) Mett.
Stumpy rosette fern, c. along stream banks in riverine and gallery forest. S : 405

B. tabulare (Thunb.) Kuhn
Large stumpy rosette fern. Very localised. May be locally abundant and gregarious in scrubby grassveld, Mistbelt. S : 970

SPERMATOPHYTA

GYMNOSPERMAE

TAXACEAE

Podocarpus falcatus (Thunb.) R.Br. ex Mirb.
Fair-sized canopy and overstory tree in high forest; rr. S : 982

P. latifolius (Thunb.) R.Br. ex Mirb.
Fair-sized canopy and overstory tree in high forest. S : 713

ANGIOSPERMAE

MONOCOTYLEDONEAE

TYPHACEAE

Typha latifolia L. subsp. capensis Rohrb.
Robust rhizomatous herb. Rather localised to locally ff. to abundant in swampy environs of streams. S : 12

POTAMOGETONACEAE

Potamogeton thunbergii Cham. et Schlechtdl. [= P. nodosus sensu auct.non Poir.]
Perennial herb with long, half-floating, half-submerged stems. Locally dominant pioneer of hydrosere in still water, Low Country. S : 849

GRAMINEAE

Imperata cylindrica (L.) Beauv.
Rhizomatous perennial grass. Widespread but rather localised. Locally ff. on disturbed sites, especially in Low Country. S : 491

Eriochrysis pallida Munro
Very localised to locally fairly common, seepages, L.S.B.T. hydrosere. S : 1158

Miscanthidium junceum (Stapf) Stapf
Large-tufted grass. Seepages, Low Country river valleys. Very localised. S : 907

Microstegium capense (Hochst.) A.Camus
Gregarious small grass forming loose mats. Localised to locally abundant especially in moist, shaded disturbed sites, especially in gallery forest. S : 245

Ischaemum arcuatum (Nees) Stapf
Widespread. Locally frequent to abundant in marshy areas. S : 160

Hemarthria altissima Stapf et C.E. Hubbard
Lax to trailing. Very localised, infrequent in moister places. S : 165

Rottboellia exaltata L.f.
Robust annual. Weed of disturbance. Widespread in Old World tropics. S : 595

Trachypogon spicatus (L.f.) O.Ktze.
Medium-sized to large-tufted sp. Widespread but rather localised and infrequently scattered to occ. locally ff. in parts of N.E. Mtn. Sourveld. S : 863

Andropogon amplectens Nees
Large-tufted. Infrequent to ff. in fire-retarded grassveld, especially below Mistbelt. S : 822

A. eucomus Nees
Small-tufted. Early stages of hydrosere and psammosere. S : 838

A. filifolius (Nees) Steud.
Small- to medium-sized sp., tufted. Rare to infrequent grass of N.E. Mtn. Sourveld. S : 966

A. gayanus Kunth. var. squamulatus (Hochst.) Stapf
Large, loosely tufted. Rr. weed of disturbance at low altitudes. S : 639

A. schirensis Hochst. var. angustifolius Stapf
Medium-sized tuft. Ff. in lithosere and retarded grassveld in L.S.B.T. S : 519, 666, 1236

Sorghum verticilliflorum (Steud.) Stapf
Robust loosely tufted short-lived grass. Localised and rr.; disturbed sites, especially in Low Country. Widespread African weed. S : 214

Bothriochloa glabra (Roxb.) A.Camus
Widespread grass in Low Country especially in wet and disturbed places. S : 275,291

Schizachyrium brevifolium (Sw.) Nees ex Buse
Small annual. Very localised and rr. to locally ff. to small almost pure stands; especially disturbed sites, Low Country. S : 933

S. jeffreysii (Hack.) Stapf
Loosely tufted grass. Very localised and rare here. Retarded summit broken lithoseral grassveld, Mistbelt. S : 960

S. semiberbe Nees
Tufted grass. Fairly widespread to locally ff. S : 584

Cymbopogon validus Stapf ex Burtt Davy
Tall tufted grass. Widespread constituent of sour grassveld and scrub. S : 79,202

Hyparrhenia cymbaria (L.) Stapf
Widespread. Large tufted grass. Important in succession especially in Mistbelt. S : 190

H. dissoluta (Nees) C.E.Hubbard
Fairly large tufted grass in early seral grassveld below Mistbelt. Infrequent. S : 244,530

H. filipendula (Hochst.) Stapf
Tufted grass. Rather infrequent. In Low Country. S : 1198

H. filipendula (Hochst.) Stapf var. pilosa (Hack.) Stapf
Tufted grass sometimes sprawling. Infrequent. In Low Country. S : 1203

H. gazensis (Rendle) Stapf
Tufted grass sometimes sprawling. Locally ff. ruderal in Low Country. S : 318

H. glauca Stent
Very robust, tall tufted grass. Especially disturbed sites in L.S.B.T. S : 242

H. hirta (L.) Stapf
Widespread tufted grass. Infrequent to locally ff. S : 582

H. rufa (Nees) Stapf
Fairly large tufted grass, especially disturbed areas in Low Country. S : 215

Monocymbium ceresiiforme (Nees) Stapf
Small-tufted grass. Common to locally subdominant, N.E. Mtn. Sourveld. S : 937

Heteropogon contortus (L.) Beauv.
Rather small tufted grass. Infrequent to rare in disturbed grassveld, L.S.B.T. S : 827

Themeda triandra Forsk.
Tufted grass. Fairly widespread but rather localised and infrequent in retarded sour grassveld. S : 527

Tragus berteronianus Schult.
Small annual. Very localised, occ. locally common, gregarious. Especially on disturbed bare areas in Low Country. S : 533

Perotis patens Gand.
Small short-lived grass of disturbed soil, seral and retarded grassveld, L.S.B.T. Localised to locally ff. S : 531

Melinis minutiflora Beauv.
Large loosely tufted grass. Localised to locally common in xeroclinal lithosere, Mistbelt. S : 1143

M. minutiflora Beauv. var. inermis Hack.
Large loosely tufted grass. Locally ff. to abundant, especially xeroclinal lithosere, Mistbelt and moister places, Low Country. S : 354

M. tenuissima Stapf
Small loosely tufted grass. Very localised in disturbed grassveld and scrubby vegetation in Low Country. Rare. S : 1153

Paspalum commersonii Lam.
Loosely tufted perennial grass. Widespread. Ff. to dominant in grassveld, scrub, scrub forest, orchards and plantations. S : 37

*P. dilatatum Poir.
Introduced South American pasture grass. Occurs very locally as an escape. S : 31

*P. notatum Flugge
Naturalised South American pasture grass. Very localised and rare escape on disturbed sites. Oakes & Scheepers : 289

*P. urvillei Steud.
Naturalised South American pasture grass. Widespread to locally ff. in hydrosere, xerosere, subseral and disturbed grassveld and scrub.
Keet : 1754; S : 44

*Axonopus compressus (Swartz) Beauv.
Stoloniferous grass forming dense mat. Localised to locally ff. escape in moist places especially in Low Country. S : 109

Panicum aequinerve Nees
Small straggly grass of moist and sometimes shady places.
Localised and rr. to infrequent. S : 260

P. glabrescens Steud.
Variable pioneers of early hydrosere, psammosere and subseres.
Localised. Infrequent. S : 86, 96, 154

P. hymeniochilum Nees var. glandulosum Nees
Spreading straggly grass of moist, shady and disturbed sites in Mistbelt, localised to locally ff. S : 702

P. maximum Jacq.
Widespread very variable grass of retarded sour grassveld especially in Low Country. Locally ff. Keet : 1757;S : 25, 146

P. monticolum Hook.f.
Fair-sized straggling grass of moist, shady and disturbed sites more especially in Mistbelt. Rather localised and infrequent to locally ff. S : 399

P. natalense Hochst.
Widespread tufted grass of lithosere and psammosere, Mistbelt and Low Country. Rather localised and infrequent to occ. locally ff. S : 768

P. novemnerve Stapf
Rather small short-lived grass of disturbed Low Country sites.
Localised and rr. S : 631

Panicum sp., cf. P. ecklonii Nees
Very localised, tufted grass. N.E. Mtn. Sourveld Glade, top of Escarpment. S : s.n.

Alloteropsis semialata (R.Br.) Hitchcock
Widespread variable species. One form infrequent in retarded grassveld in L.S.B.T. Large tussocks of hairy form important in summit N.E. Mtn. Sourveld. S : 776,835

Urochloa mosambicensis (Hack.) Dandy
Variable loosely tufted perennial. Rather localised, infrequent to occ. locally ff., especially on disturbed grassveld sites, Low Country.
S : 177,829

U.panicoides Beauv.
Loosely tufted annual. Rather localised, infrequent. Widespread weed of disturbed sites, especially in Low Country. S : 520

Brachiaria brizantha(Hochst.) Stapf
Widespread grass but rather localised and infrequent. Especially in moist and disturbed sites. S : 286

*Echinochloa pyramidalis (Lam.) Hitchcock et Chase
Robust hydrophytic grass. Introduced from the Lowveld. S : 207

E. stagnina (Retz.) Beauv.
Very localised hygrophyte near water. S : 287

Digitaria adscendens (H.B.K.) Henrard
Short-lived weed of disturbance. S : 32, 65, 84

D. apiculata Stent
Locally important tufted perennial in N.E. Mtn. Sourveld. S : 831

D. debilis (Desf.) Willd.
Locally important pioneer in secondary psammosere and hydrosere. S : 169

D. diagonalis (Nees) Stapf
Tufted perennial of retarded disturbed grassveld in Low Country and Mistbelt. S : 528

*D. diversinervis (Nees) Stapf
Introduced for lawns and soil conservation. Occ. escape. S : 977

D. longiflora (Retz.) Pers.
Prostrate pioneer of bared and disturbed soil. S : 567

D. milanjiana (Rendle) Stapf
Localised tufted perennial especially of disturbed sites in Low Country. S : 853

D. monodactyla (Nees) Stapf
Localised tufted perennial especially of rocky retarded N.E. Mtn. Sourveld. S : 1085

*D. scalarum (Schweinf.) Chiov.
Introduced for pasture and conservation work. Locally troublesome. S : 645

*D. swazilandensis Stent
Introduced indigenous lawn grass. S : 1235

D. ternata (Hochst.) Stapf
Short-lived weed of moister disturbed sites. S : 92

D. zeyheri (Nees) Henr.
Widespread short-lived weed of disturbance. S : 918

Stereochlaena cameronii (Stapf) Pilger
Small-tufted fair-sized sp. Rather localised to occ. locally ff., gregarious. In rock mat formation and secondary psammosere, L.S.B.T., and xeroclinal lithosere in Mistbelt. In seral grassveld. S : 892

Rhynchelytrum repens (Willd.) C.E. Hubbard
Variously repent to tufted grass. Widespread. In subseres, lithosere and sour grassveld. S : 322

R. rhodesianum (Rendle) Stapf et Hubbard
Small- to medium-sized tufted grass. Very localised to locally ff. In broken lithosere, Mistbelt xerocline. S : 1142

Oplismenus hirtellus (L.) Beauv.
Widespread low straggling grass under forest and scrub forest. Locally frequent to dominant in field layers. S : 236

Setaria chevalieri Stapf ex Stapf et C.E. Hubbard
Robust tufted grass. Widespread and c. especially in Low Country grassveld, scrub, scrub forest, savanna woodland and gallery forest. S : 9

S. flabellata Stapf
Small to medium-sized tufts. Rather localised and infrequent in disturbed retarded grassveld. S : 1037

S. homonyma (Steud.) Chiov.
Small loosely tufted annual. Very localised to locally ff., in moister shady, disturbed places. S : 916

S. pallide-fusca (Schumach.) Stapf et C.E. Hubbard
Loosely tufted sp. Localised to locally ff. in moister shady disturbed places. S : 553

S. sphacelata (Schumach.) Stapf et C.E. Hubbard
Small to medium-sized tufted sp. Widespread but rather localised and infrequent to locally ff. In disturbed and retarded grassveld and scrub. S : 173

S. verticillata (L.) Beauv.
Widespread weed of disturbance. Infrequent here. S : 594

Cenchrus ciliaris L.
Rarely encountered in retarded grassveld in L.S.B.T. S : 741

Pennisetum macrourum Trin.
Large densely tufted perennial grass of moist to saturated soils. Localised. Locally infrequent to dominant. S : 7

P. natalense Stapf
Densely tufted grass attached to rocks in beds of swiftly flowing streams. Very localised. Restricted to this habitat. S : 263

P. purpureum Schum. x P. typhoides (Burm.) Stapf et Hubbard
This hybrid fodder grass occurs as an occ. escape. S : 309

Prosphytochloa prehensilis (Nees) Schweick.
Scrambling grass of moist, shaded cool stream-banks. Very localised to locally ff. in forests, Mistbelt. S : 934

Leersia hexandra Swartz
Locally tufted to trailing. Important in early stages of hydrosere. S : 2

Ehrharta erecta Lam.
Straggly grass of moist, cool, shady and, often, disturbed sites. S : 401

Aristida congesta Roem. et Schult. subsp. barbicollis (Trin. et Rupr.) de Wint.
Rather rare pioneer grass of disturbed grassveld, L.S.B.T. S : 826

A. transvaalensis Henr.
Tufted grass. Localised, locally common pioneer of Mistbelt lithosere. S : 955

Pseudobromus africanus (Hack.) Stapf
Tufted grass of floor, high forest. Localised to locally ff. S : 674

Sporobolus centrifugus Nees
Medium-sized to large-tufted sp. Rather localised. Rather infrequently scattered in sour grassveld, in Mistbelt. S : 874

S. fimbriatus Nees var. latifolius Stent
Fair-sized tufted sp. Rather localised; infrequent to occ. locally ff. in disturbed places, Low Country. S : 636,798

S. pyramidalis Beauv.
Densely tufted sp. Widespread, locally ff. to dominant in disturbed, retarded grassveld. Keet: 1755; S : 30, 43

S. stapfianus Gand.
Small tufted sp. Fairly widespread but very localised to locally ff. on disturbed or seral sandy soil. Subsere, psammosere or rock mat formation, especially in Low Country. S : 779

Agrostis lachnantha Nees
Small-tufted sp. Fairly widespread but rather localised to locally ff. along rocky stream-banks, especially above about 900 m. S : 535

Helictotrichon turgidulum (Stapf) Schweick.
Rather rare. Localised L.S.B.T. lithosere. S : 1201

Tristachya hispida (L.f.) K.Schum.
Medium-sized tufted sp. Widespread but rather localised, infrequent to occ. locally ff. in retarded grassveld especially in Low Country. S : 781

Trichopteryx dregeana Nees
Tangled massed straggling perennial sp. Very localised, gregarious on seepages, river banks, L.S.B.T. S : 642

Loudetia simplex (Nees) Hubbard
Variable tufted sp. Widespread to locally abundant to (co-) dominant in N.E. Mtn. Sourveld. S : 583,946

Microchloa caffra Nees
Small tufted grass. Localised to locally ff. to c. especially in Low Country lithosere and subseres. S : 810

Rendlia altera (Rendle) Chiov.
Large tufts. Very localised. Locally abundant: subdominant to codominant in northwestern-aspect xeroclinal lithoseral grassveld. Mistbelt. S : 1233

Cynodon dactylon (L.) Pers.
Widespread mat-forming grass. Pioneer on bare disturbed areas. S : 42

*C. plectostachyus (L.) Pers.
Widely naturalised and very troublesome especially in Low Country. Introduced from East Africa. S : 148,221

Harpechloa falx (L.) O.Ktze.
Localised to locally codominant in N.E. Mtn. Sourveld. S : 1061

Chloris gayana Kunth
Apparently mostly adventive in disturbed places especially roadsides. S : 941

C. pycnothrix Trin.
Variable-sized grass of disturbed sites. Widespread. S : 83,1138

Tripogon abyssinicus Nees
Small tufted sp. Very localised and rr. Pioneer grass of rock mat formation, L.S.B.T. S : 1208

Eleusine africana Kennedy O'Byrne
Widespread ruderal and weed of cultivation and disturbance. S : 216

Phragmites communis Trin.
Robust grass. Locally important in hydrosere. S : 976

Pogonarthria squarrosa (Licht.) Pilg.
Tufted grass of lithosere and secondary psammosere, L.S.B.T.
Localised to locally ff. S : 794

Eragrostis arenicola C.E. Hubbard
Weed of disturbance: cultivation and especially roadsides,
Low Country. S : 630

E. aspera (Jacq.) Nees
Widespread weed of disturbed bare soil. S : 603

E. atrovirens (Desf.) Trin.
Localised pioneer of rocky river-bed succession, Low Country. S : 641

E. capensis (Thunb.) Trin.
Widespread to locally ff. Sour grassveld. S : 796

E. ciliaris (L.) R.Br.
Widespread weed of disturbance, especially in Low Country. S : 894

E. curvula (Schrad.) Nees
Widespread, variable grass of early seral and subseral
grassveld and bare soil. S : 26, 45, 224, 637

E. gummiflua Nees
Localised. Early stages of secondary psammosere, L.S.B.T. S : 792

E. patentissima Hack.
Very localised and rr. in N.E. Mtn. Sourveld. S : 1097

E. racemosa (Thunb.) Steud.
Widespread to locally ff. in sour grassveld. S : 580

E. superba Peyr.
Apparently rare here. Adventive, L.S.B. element in Low Country. S : 1084

Koeleria cristata (L.) Pers.
Small tufted grass of rocky, fire-retarded Mistbelt grassveld.
Very localised to locally frequent. S : 1032

*Poa annua L.
Widespread introduced temperate weed of disturbance. Very
localised. S : 860

*Bromus willdenowii Kunth
Widespread naturalised weed of disturbance. Localised. S : s.n.

Brachypodium flexum Nees
Very localised. Locally abundant in N.E. Mtn. Sourveld
along forest margin. S : 885

CYPERACEAE

Lipocarpha senegalensis (Lam.) T. et H.Dur.
Rather small sedge. Localised. Infrequent on wet sandbanks. S : 352

Cyperus albostriatus Schrad.
Pioneer in xerosere and occ. in hydrosere, to undergrowth in forest and wood-
land types. Widespread in Mistbelt and Low Country. Locally ff. S : 51, 62

C. amabilis Vahl
Small sedge. Locally abundant pioneer of secondary psammosere,
L.S.B.T. Gregarious in colonies. Very localised. S : 893

C. compactus Lam.
Locally ff. sedge of retarded grassveld, Low Country. S : 507

C. dichroostachyus Hochst.
Rr. Early stages of hydrosere. S : 380

C. distans L.f.
Locally ff. in moist and often shady places. S : 63,353

C. esculentus L.
Locally ff. to common weed of disturbance. S : 566

C. haspan L.
Pan-tropical. Localised to locally ff. in earlier stages of xerosere. S : 382

C. immensus C.B.Cl.
Very robust sedge. Widely scattered to locally common in earlier stages of hydrosere. Localised. S : 150

C. latifolius Poir.
Robust sedge. Widely scattered to locally common in earlier stages of hydrosere. Localised. S : 801

C. longus L.
Localised. Very infrequent to locally ff. in moist places. S : 864

C. papyrus L. subsp. nyassicus Chiov.
Very robust sedge. Pioneer in hydrosere, L.S.B.T. First record of subspecies in S.A. Very localised. Locally ff. S : 773

C.pseudoleptocladus Kuekenth. var. polycarpus Kuekenth.
Very localised. Locally ff. (gregarious). In open parts of riverine forest in Mistbelt. S : 1180

*?C. rotundus L.
Weed in nurseries, occ. along roadsides etc. Cosmopolitan. S : s.n.

C. rupestris Kunth.
Localised pioneer in rock mat formation, L.S.B.T. S : 1207

C. semitrifidus Schrad.
Localised small pioneer in lithosere and psammosere, Mistbelt. S : 1086

Cyperus sp.?, cf. Mariscus elephantinus C.B.Cl.
Tall sedge. Localised. Occ. locally ff. to infrequently scattered in early stages of hydrosere. S : 284

Pycreus angulatus Nees
Slender sedge. Very localised and infrequent. Seepages, L.S.B.T. S : 1132

P. elegantulus C.B.Cl.
Tufted sedge. Localised to locally ff. gregarious. In saturated soil, Mistbelt. S : 572

P. lanceus (Thunb.) Turrill
Sedge in loose mats. Localised to locally ff. gregarious in periodically wet to water-logged soil. Low Country. S : 518

P. mundii Nees
Creeping grass-like sedge. Widespread to locally ff. Seepages, water's edge, early hydrosere etc. S : 166,508

P. polystachyos Beauv.
Tufted sedge of sunny, rocky stream banks. Localised to locally ff. especially in Low Country. S : 888

P. rehmannianus C.B.Cl.
Small tufted sedge. Very localised and infrequent. Seepages, L.S.B.T. S : 1155

Mariscus aristatus (Rottb.) Cherm.
Small to minute sedge of moist seepage areas on solid rock, Low Country. S : 1150

M. congestus C.B.Cl.
Fair-sized sedge. Localised to locally ff., especially in moist disturbed open parts of forest. S : 536

M. firmipes C.B.Cl.
Tropical African. New record for S.A. Localised. Early-stage subseral grassveld and psammosere, L.S.B.T. S : 840

M. sieberianus Nees
Widespread weed of disturbance and cultivation. S : 27,28

Kyllinga cylindrica Nees
Widespread low herb of disturbed and retarded grassveld. S : 19

K. melanosperma Nees
Localised to locally common densely tufted sedge of marshy places. S : 167

Kyllinga pauciflora Ridl.
Very localised to locally abundant sedge of waterlogged seepages. S : 1190

Ficinia filiformis Schrad.
Small tufted sedge in retarded rocky N.E. Mtn. Sourveld. S : 1019

Ficinia sp., cf. F. stolonifera Boeck.
Tufted sedge. Very localised and rr. Marginal-Mistbelt rocky sourveld. S : s.n. (PRE: 29908)

Fuirena pachyrrhiza Ridl.
Robust. In sedge-marsh and marsh-meadow. S : 229,570

Scirpus inclinatus (Del.) Aschers. et Schweinf. [= S. corymbosus Roth]
Robust sedge. Localised, locally ff. to dominant in early stages of hydrosere. S : 5,462

S. macer Boeck.
Tufted sedge. Localised to locally ff. to abundant on waterlogged soil. S : 454

S. setaceus L.
Small tufted sedge. Very localised pioneer on bare unstabilised silt, hydrosere and hydropsammosere. S : 379

Fimbristylis capillaris Kunth var. trifida (Nees) Koyama [= Bulbostylis trifida (Nees) Nelmes] [= B. densa (Wall.) Hand.]
Small sedge. Rr. here. Localised. In montane seepages. S : 1141

F. dichotoma Vahl
Variable-sized tufted sedge of disturbed areas. S : 381,605

F. hispidula (Vahl) Kunth
Small tufted sedge. Early stages of (disturbed) seral grassveld. S : 793

Bulbostylis boeckeleriana (Schweinf.) Beetle forma
Lax sedge. Hydrophytic tropical form. Very localised. Undergrowth of Syzygium cordatum Consocies; seepages, L.S.B.T. hydrosere. S : 1006

B.burchellii (Fical. et Hiern) C.B.Cl.
Locally in disturbed and retarded Marginal-Mistbelt rocky mountain sourveld. S : s.n.

B. collina (Kunth) C.B.Cl.
Locally in disturbed and retarded rocky mountain sourveld. S : 1126

B. oritrephes (Ridl.) C.B.Cl.
Locally in disturbed and retarded rocky mountain sourveld. S : s.n.

Rhynchospora glauca Vahl
Tufted sedge. Localised. Locally ff. to abundant on seepages, especially in Low Country. S : 740

Coleochloa setifera (Ridl.) Gilly
Important chasmophyte in Mistbelt lithosere. S : 956

Schoenoxiphium sparteum (Wahl.) Kuekenth.
Tufted sedge. Widespread, ff. on moister marginal and disturbed sites. Especially in Low Country and Marginal Mistbelt. S : 546

Carex aethiopica Schkuhr
Robust sedge. Locally near water in Low Country. S : 763

C. spicato-paniculata C.B.Cl.
Widespread robust sedge. Present to frequent in most seral to climax communities. S : 61

ARACEAE

Zantedeschia tropicalis (N.E.Br.) C.Letty
Variable-sized perennial herb. Fairly widespread but scattered to occ. locally ff. in grassveld, scrub forest, scrub and plantations especially in Low Country. S : 36

XYRIDACEAE

Xyris capensis Thunb. var. medullosa N.E.Br.
Slender grass-like herb. Very localised. Occ. locally ff. on saturated soil, hydrosere and hydrolithosere. S : 706

X. rehmannii A. Nilss.
Robust tufted grass-like herb. Very localised and rr. On saturated soil, hydrosere and hydrolithosere. S : 762

ERIOCAULACEAE

Eriocaulon sonderianum Koern.
Very localised to locally common. Seepage areas, hydrolithosere and hydrosere. S : 707

COMMELINACEAE

Commelina africana L.
Herb of grassveld and earlier seral and subseral stages. S : 53

C. benghalensis L.
Herb of grassland and earlier seral and subseral stages. S : 57

C. diffusa Burm.f.
Pan-tropical weed of disturbance. S : 4, 56, 60, 188, 1204

C. eckloniana Kunth
Herb of seral scrub and scrub forest, especially in Mistbelt and near water. S : 1205

Aneilema aequinoctiale Kunth
Trailing to scrambling herbaceous plant of undergrowth of moist areas. S : 59

Cyanotis nodiflora Kunth
Localised to locally ff. herb of Mistbelt lithosere. S : 788

Floscopa glomerata Hassk.
Localised herb, half-floating in open water and in extremely wet situations, e.g. seepages. S : 6

JUNCACEAE

Juncus brevistylis Buchen.
Very localised to locally abundant tufted hydrophyte especially in L.S.B.T. S : 1005

J. lomatophyllus Spreng.
Localised to locally common hydrophytic rosette herb. S : 726,735

J. rostratus Buchen.
Very localised hydrophytic to hygrophytic loosely tufted herb. S : 559

LILIACEAE

Gloriosa superba L.
Rr. on the whole, localised and gregarious in L.S.B.T. and L.S.B. S : 1096

Littonia modesta Hook.f.
Small herbaceous scrambler in Mistbelt scrub and scrub forest. Localised and infrequent. S : 877

Anthericum cooperi Bak.
Rare geophytic herb in grassveld and scrub. S : s.n.

A. galpinii Bak.
Infrequent, inconspicuous herb in disturbed grassveld. S : 471

A. transvaalense Bak.
Infrequently scattered, gregarious herb in disturbed grassveld. S : 689

Trachyandra saltii (Bak.) Oberm. var. secunda (Krause et Dinter) Oberm.
Low perennial herb. Widespread but rather localised, infrequent to locally ff., especially in fire-retarded grassveld in Low Country. S : 736

Chlorophytum bowkeri Bak.
Widespread. Scattered to locally gregarious. Rocky open sourveld to open woodland. S : 1115

C. comosum (Thunb.) Jacques
Rather localised to locally abundant gregarious herb of high forest undergrowth. S : 592

Eriospermum cooperi Bak.
Widespread geophytic herb, often in disturbed areas. S : 806,868

E. tenellum Bak.
Very small forb. Very localised to occ. locally ff., rock mat formation, northwestern-aspect lithosere, Mistbelt. S : 1183

Kniphofia splendida E.A.Bruce
Stout rosette plants especially in Mistbelt. Infrequent to locally ff. in N.E. Mtn. Sourveld. S : 626,925

Aloe arborescens Mill.
Widespread shrubby species of lithosere in Mistbelt. Rather localised here. S : 426

A. boylei Bak.
Semisucculent, subwoody herb. Locally frequent in N.E. Mtn. Sourveld. S : 926

A. greatheadii Schonl.
Succulent rosette herb. In open and scrubby lithoseral communities, especially of higher altitudes. S : 992

A. lettyae Reynolds
Succulent rosette herb. Endemic in the Escarpment area of the Letaba District. Especially at lower altitudes. Cythna Letty: 299; S :904

Agapanthus inapertus Beauv.
Perennial herb. Widespread from N.E. Mtn. Sourveld to L.S.B.T. Infrequent to locally ff. S : 80

Tulbaghia alliacea L.
Small bulbous geophyte. Localised, infrequent to occ. locally ff. in disturbed N.E. Mtn. Sourveld. S : 1016

Albuca setosa Jacq. [= A. pachychlamys Bak.]
Low bulbous herb. Localised, infrequent to locally ff. vernal and aestival aspect component of retarded grassveld, especially in Low Country. S : 687

Albuca sp., cf. A. fastigiata (L.f.) Dryand.
Tall bulbous herb. Fairly widespread but infrequent to occ. locally f. vernal and aestival aspect component of retarded grassveld. S : 1114

Urginea multisetosa Bak.
Bulbous herb. Localised. Locally infrequent. Especially in fire-retarded sour grassveld, Low Country. S : 686

U. pretoriensis Bak.
Very small bulbous herb. Very localised. Especially with tufts of Coleochloa setifera in crevices, mesoclinal summit lithosere of N.E. Mtn. Sourveld. S : 1020

Drimia alta R.A.Dyer
Localised bulbous forb, retarded early seral grassveld, Low Country. S : 715

D. sphaerocephala Bak.
Small bulbous herb rarely encountered in Coleochloa tufts, Mistbelt lithosere. Very localised. S : s.n.

Dipcadi viride (L.) Moench
Widespread adaptable herb of early stages of lithosere, psammosere and disturbed grassveld. Infrequent to occ. locally ff., especially in Low Country. S : 554, 1047, 1053

Scilla cooperi Hook.f.
Bulbous rosette herb of moist to wet places. Fairly widespread but localised to locally ff. S : 695

S. glaucescens v.d.Merwe
Bulbous geophyte. Rather localised to locally ff., especially in disturbed, retarded sour grassveld, Mistbelt. S : 1055

S. natalensis Planch.
Robust bulbous rosette herb. Rather localised to locally ff., in early lithosere, Mistbelt. S : 787

Scilla sp., cf. S. ovatifolia Bak.
Variable-sized bulbous geophyte. Fairly widespread to locally ff. in fire-retarded grassveld, Low Country. S : 468

Schizocarphus nervosus (Burch.) v.d. Merwe
Bulbous rosette herbs. Localised, occ. locally ff. to common in broken lithoseral N.E. Mtn. Sourveld. S : 758

Eucomis undulata Ait.
Widespread bulbous herb. Infrequently scattered in grassveld, and relics in woodland and plantation, Low Country and Mistbelt. S : 297

Ornithogalum virens Lindl.
Bulbous perennial herb. In small "clans" in N.E. Mtn. Sourveld. Very localised. S : 815

Drimiopsis sp., cf. D. woodii Bak.
Small bulbous herb. Localised: occ. locally common on disturbed sites. S : 770

Asparagus africanus L.
Widespread variable subscandent bush of seral open to scrubby grassveld of L.S.B.T. to N.E. Mtn. Sourveld. S : 493, 1028, 1029

A. asparagoides (L.) Druce
Herbaceous twiner of scrub, scrubby grassveld and scrub forest. S : 196

A. falcatus L.
Robust spiny climber in high forest, scrubby forest and gallery forest. S : 731

A. plumosus Bak.
Widespread soft twiner in undergrowth of high forest and scrubby forest. S : 896

A. saundersiae Bak.
Suberect to sprawling and scrambling bush of scrub and scrub forest. S : 1059

A. virgatus Bak.
Variable-sized herbaceous bush of undergrowth of forest, scrub forest, scrub and gallery forest. Locally abundant to subdominant. S : 328

Behnia reticulata (Thunb.) Didrichs.
Perennial herbaceous twiner of forest, scrub forest and gallery forest. S : 680

Smilax kraussiana Meisn.
Climber. Widespread. Ff. to locally common. In grassveld, scrub, scrub forest, gallery forest and savanna woodland. S : 153,199

AMARYLLIDACEAE

Haemanthus magnificus Herb.
Widespread. Infrequent to occ. locally abundant herb, especially in moister, shady places. S : 771

Clivia caulescens R.A. Dyer
Prostrate-stemmed perennial herb of epiphytic or ground flora in Mistbelt high forest and scrub forest. Rather localised to locally abundant. S : 407,413

Crinum macowanii Bak.
Robust bulbous rosette plant. Frequent in Low Country. S : 842

Cyrtanthus stenanthus Bak.
Very localised herb of N.E. Mtn. Sourveld. Rare here. S : 1041

Hypoxis angustifolia Lam.
Small grass-like plant scattered through seral grassveld, Mistbelt and Low Country. S : 34

H. rigidula Bak.
Herbs of seral grassveld. Infrequent to locally ff. S : 737

H. rooperi S.Moore
Robust herb scattered in seral grassveld, especially in Low Country. S : 32

VELLOZIACEAE

Vellozia villosa Bak.
Short woody perennial. Widespread but rather localised, infrequent to locally ff. in early lithosere. Often small. S : 1034

DIOSCOREACEAE

Dioscorea cotinifolia Kunth
Widespread perennial soft twiner. Rather infrequent. S : 803

D. dregeana Bak. var. hutchinsonii Burkill
Widespread but rr. perennial soft twiner. S : 774

D. retusa Mast.
Infrequent perennial soft twiner. Widespread. S : 830,882

IRIDACEAE

Moraea sp., aff. M. spathulata Klatt
Robust herb with perennial corm. Locally ff. to frequent, N.E. Mtn. Sourveld. S : 622

Moraea sp., aff. M. trita N.E.Br.
Small herb with perennial corm. Locally infrequent to ff. in retarded grassveld. Widespread but very localised, especially L.S.B.T. S : 1164

Dietes vegeta (L.) N.E.Br.
Herb in undergrowth of high forest, high scrub forest and gallery forest. Gregarious, in colonies. S : 738

Aristea ecklonii Bak.
Widespread herb from L.S.B.T. to top of Escarpment, especially moist open places. S : 742,746

A. woodii N.E.Br.
Localised herb in N.E. Mtn. Sourveld. S : 579

Dierama medium N.E.Br.
Tall, slender forb in N.E. Mtn. Sourveld. S : 756

Crocosmia aurea Planch.
Geophytic herb of lightly shaded moist places in Mistbelt. S : 185,619

Gladiolus papilio Hook.f.
Very localised geophytic herb of marshy places. S : 870

G. psittacinus Hook.f.
Infrequent to locally ff. geophytic herb, especially of disturbed grassveld in Low Country. S : 118

G. woodii Bak.
Widespread small geophytic herb. Infrequent to locally ff., gregarious especially in disturbed grassveld. S : 795

Gladiolus sp.
Infrequent geophytic herb of disturbed and lithoseral grassveld especially in Low Country. S : 222

Gladiolus sp., cf. G. crassifolius Bak.
Geophytic herb. Rather localised, infrequent to locally ff. in N.E. Mtn. Sourveld (summit type). S : 952,967

Lapeirousia grandiflora Bak.
Small perennial herb of grassveld and scrubby vegetation. Widespread and locally ff. S : 136,200

Watsonia transvaalensis Bak.
Robust tufts of equitant leaves. Very localised to locally ff. to c. Mesic summit (lithoseral) scrubby N.E. Mtn. Sourveld. S : 953

MUSACEAE

Ensete ventricosum (Welw.) Cheesman
Giant herb of permanently wet creeks in Mistbelt. S : 962

Strelitzia caudata R.A.Dyer
Slender small "trees" or "shrubs". Rather localised. Locally ff. to abundant on scrubby lithoseral mesoclinal slopes, Mistbelt. S : 428

CANNACEAE

*Canna indica L.
Garden escape, especially along stream-banks. S : 240

ORCHIDACEAE

Stenoglottis fimbriata Lindl. var. saxicola Schltr. ex Kraenzl.
Small epiphytic orchid. Fairly widespread but very localised. Locally occ. ff. to numerous, gregarious. Rough bark, gallery forest. Also on rocks in Mistbelt. S : 155

Habenaria caffra Schltr.
Localised. Disturbed grassveld in L.S.B.T. S : s.n.

Habenaria sp.
Terrestrial orchid, geophytic herb. Localised. Low Country up to Mistbelt. S : 915

Brachycorythis ovata Lindl. subsp. ovata
Ground orchid in seral rocky grassveld, Mistbelt. Rare. S : 1082

Satyrium longicauda Lindl.
Small geophytic herb. Rather infrequently scattered to locally ff. especially on disturbed sites, N.E. Mtn. Sourveld. S : 833

S. neglectum Schltr.
Geophytic herb. Very localised and infrequent. Disturbed grassveld bordering forest, Marginal Mistbelt. S : s.n.

S. parviflorum Swartz
Robust, geophytic herb. Very localised, locally ff. to common, gregarious. Undergrowth of lithoseral scrub and scrub forest, Mistbelt mesocline. S : 1139

Disa patula Sond. var. transvaalensis Summerhayes
Localised ground orchid in disturbed grassveld, Marginal Mistbelt. S : 1100

Disperis lindleyana Reichb.f.
Very localised to gregarious. In humus and litter atop rocks in Montane high forest. Rare. S : 1186

Liparis neglecta Schltr.
Small terrestrial orchid in moist, shaded forest and scrub forest, Mistbelt. S : 866

Polystachya imbricata Rolfe
Large-tufted epiphytic orchid of gallery forest and high forest, especially in Mistbelt. Localised to locally common. New record for S.A. S: 411,784

P. ottoniana Reichb.f.
Small epiphytic orchid with rows of pseudobulbs forming mats on trees in Mistbelt. Rather localised to locally fairly abundant. S: 724

P. tesselata Lindl.
Epiphytic orchid with short rows of pseudobulbs, in Low Country gallery forest. Very localised and rare here. S : 906

Polystachya sp., aff. P. zambesiaca Rolfe
Rather small epiphytic orchid with short rows of pseudobulbs. In lower Mistbelt and Low Country gallery forest. Localised and infrequent to locally ff. S : 703

Ansellia gigantea Reichb.f. var. gigantea
Large-tufted epiphyte. Ornamental. Rare here. S : 1081

Oberonia disticha (Lam.) Schltr.
Small clustered epiphytic orchid on upright rough-barked boles in gallery forest, Low Country. Localised and very rare. New record for S.A. S : 899

Calanthe natalensis Reichb.f.
Rr. ground orchid of gallery forest, swamp forest etc., wherever excess of water. S : 557

Eulophia angolensis (Reichb.f.) Summerhayes [= Lissochilus buchananii Reichb.f.]
Localised. Robust herb of marshes (especially below Mistbelt). S : 871

E. clavicornis Lindl. var. clavicornis [E. hians sensu auct.]
Localised, small herb of retarded grassveld, Low Country. S : 1003

E. clavicornis Lindl. var. inaequalis (Schltr.) Hall [= E. inaequalis Schltr.]
Localised small herb of retarded grassveld, Low Country. S : 995

E. odontoglossa Reichb.f. [= E. shupangae (Reichb.f.) Kraenzl.]
Widespread but very infrequent. In grassveld and scrub. Mistbelt and Low Country. S : 824

E. parviflora (Lindl.) Hall [= Lissochilus parviflorus Lindl.]
Localised herb of retarded grassveld, Low Country. S : 700

E. parvilabris Lindl.
Localised herb of retarded grassveld, Mistbelt. S : 872

E. streptopetala Lindl. [= E. paivaeana (Reichb.f.) Summerhayes subsp. paivaeana] [= E. krebsii (Reichb.f.) H.Bol.] [= Lissochilus krebsii Reichb.f.]
Widespread to locally ff. Mistbelt and Low Country. Under light shade. S : 514

Bulbophyllum sandersonii Reichb.f.
Epiphytic orchid in Low Country gallery forest and also in Mistbelt forests. Especially in L.S.B.T. S : 745

Tridactyle tricuspis (H.Bol.) Schltr.
Loosely tufted epiphytic orchid. Localised to occ. locally ff. in marginal forest and high forest. S : s.n.

Jumellea filicornoides (De Wild.) Schltr.
Tufted epiphytic orchid along gallery forest in Low Country. Locally common. First record for South Africa. S : 157

Aerangis mystacidii (Reichb.f.) Schltr.
Epiphytic orchid especially in gallery forest in the Low Scrub Forest Zone. S : 251

Cyrtorchis arcuata (Lindl.) Schltr.
Epiphytic orchid in lower crowns of gallery forest trees, L.S.B.T. S : 900

C. praetermissa Summerhayes
Epiphytic orchid in upper crowns of gallery forest trees, L.S.B.T. S : 861

Mystacidium caffrum (H.Bol.) H.Bol.
Small epiphytic orchid. Locally ff. in high forest, especially on windward slopes, Mistbelt. Localised. S : 1193

M. venosum Harv. ex Rolfe
Small epiphytic orchid. Locally ff. to common in gallery forest, Low Country. Localised. S : 250

DICOTYLEDONEAE

PIPERACEAE

Piper capense L.f.
Soft shrub of moist shady places in high forest. Locally ff. to abundant. S : 537

Peperomia reflexa (L.f.) A.Dietr.
Pan-tropical succulent epiphyte. Gallery forest trees and in kloofs etc., especially in Low Country. S : 69

P. retusa (L.f.) A.Dietr.
Succulent epiphytic herb, also on rocks. Rather localised to locally ff., especially in Mistbelt. S : 601

SALICACEAE

Salix woodii Seem.
Small tree. Very localised to fairly common locally. In unstabilised reed-swamp, L.S.B.T. S : 1196

MYRICACEAE

Myrica pilulifera Rendle
Small tree. Locally f. to dominant on mesoclinal and summit lithosere, Mistbelt. S : 433,677

ULMACEAE

Celtis africana Burm.f.
Medium-sized to tall tree. Rather infrequently scattered in scrub, scrub forest, riverine forest, high forest, and forest margins. S : 1007

Trema orientalis (L.) Blume [= T. guineensis (Schumach. et Thonn.) Fical.]
Small to medium-sized tree. Fairly widespread pioneer tree especially in Low Country on deeper moister soils. S : 10,253

MORACEAE

Ficus burkei Miq.
Fair-sized tree. Rarely encountered. L.S.B.T., Ridge Variant. S : 1129

F. capensis Thunb.
Fair-sized tree. Widespread to locally ff. Seral in upper Mistbelt, climax below. S : 1123

F. craterostoma Warb. ex Mildbr. et Burrett
Strangler in high forest. Locally ff. to common. S: 983,1199

F. ingens Miq.
Small to fair-sized tree. Widespread but localised on rocks, lithosere of Low Country and Mistbelt. S : 990

F. petersii Warb.
Rr. Strangler. Localised L.S.B. element. S : 1159

F. sycomorus L.
Rr. Fair-sized to large tree. Localised L.S.B. element. S : 1128

URTICACEAE

Fleurya alatipes N.E.Br.
Rare adventive of wet disturbed sites in high forest. S : 975

F. mitis Wedd.
Suffrutescent to lianoid herbaceous perennial. Infrequent to locally ff. in moist, shady, disturbed sites. S : 588,618

Pilea worsdellii N.E.Br.
Small herb of wet, cool shady places in riverine high forest, Mistbelt. Very localised, locally ff., gregarious. S : 590

Pouzolzia parasitica Schweinf.
Widespread soft undershrub of high forest, gallery forest and scrub forest. Rather localised to locally ff. S : 547

Droguetia woodii N.E.Br.
Lax to prostrate herb. Rr. and localised to locally ff. in moist, disturbed shady places in Mistbelt. S : 616

Australina acuminata Wedd.
Localised weed of disturbance in forest, along roads and paths. S : 1182

PROTEACEAE

Faurea saligna Harv.
Rather small to medium-sized tree. In scrub and climax savanna woodland, especially in Low Country. S : 550

F. speciosa Welw.
Small tree. Lowveld to Mistbelt. Locally important in succession. S : 394,67

Protea gaguedi Gmel.
Small tree or shrub. Very localised and rare here, xeroclinal lithoseral grassveld, Mistbelt. S : s.n.

P. rhodantha Hook.f.
Small tree in N.E. Mtn. Sourveld and scrub, Mistbelt. Localised. May be locally ff. on mesoclinal lithoseral scrub, Mistbelt. S : 880

LORANTHACEAE

Loranthus dregei Eckl. et Zeyh.
Woody hemiparasitic epiphytic bush. Apparently rare in high forest. S : 844

SANTALACEAE

Osyridicarpos schimperianus (Hochst. ex A.Rich.) A.DC.
Sprawling, straggling shrub. Fairly widespread though infrequent. In scrub and seral scrub forest. Hemiparasitic. S : 665

Thesium asterias A.W. Hill
Subwoody, perennial bushy forb. Rather localised, infrequent to locally ff. in broken lithoseral N.E. Mtn. Sourveld. Hemiparasitic. S : 732

T.costatum A.W.Hill
Small virgate perennial forb. Fairly widespread but localised to locally ff., especially in retarded sour grassveld, Low Country. Hemiparasitic. S : 484

BALANOPHORACEAE

Sarcophyte sanguinea Sparm.
Dioecious herbaceous parasite on tree roots in mesophytic scrub, Low Country. Very localised and infrequent. S : 777

ARISTOLOCHIACEAE

*Aristolochia elegans Mast.
Soft liane. Garden escape. Naturalised in eucalypt plantations, Low Country. S : 142

POLYGONACEAE

Emex australis Steinh.
Widespread weed of cultivation and disturbance. Rare here. S : 928

*Rumex crispus L.
Herbaceous weed of disturbance. Very localised and infrequent. S : s.n.

R. sagittatus Thunb.
Perennial herbaceous twiner. Widespread but infrequent. S : 602,611

*?Polygonum nepalense Meisn.
Lax to trailing soft herb of moist disturbed site in Mistbelt. Very localised rare ruderal. S : 1130

P. pulchrum Blume [= P. tomentosum Willd.]
Low suffrutescent herb. Infrequent. Localised pioneer of hydrosere and moist disturbed sites. S : 55

P. salicifolium Brouss.
Lax to trailing herb of earlier stages of hydrosere. Localised. Locally ff. S : 17

P. senegalense Meisn.
Robust suffrutescent herb of earlier stages of hydrosere, Low Country. Rather localised and infrequent. S : 18, 575

P. senegalense Meisn. forma albotomentosum R.Grah.
Fairly robust suffrutescent herb of earlier stages of hydrosere. Localised. May be locally ff. S : 152

P. strigosum R.Br.
Lax to trailing herb of earlier stages of hydrosere. Localised pioneer occ. locally ff. S : 3, 558

CHENOPODIACEAE

*Chenopodium album L.
Widespread temperate weed of disturbance. S : 373

*C. ambrosioides L.
Widespread introduced weed of disturbance. S : 356,364

*C. murale L.
Widespread introduced weed of disturbance. S : s.n.

C. schraderianum Schult.
Widespread African weed of disturbance. Localised. Occ. Locally ff. on disturbed sites, Mistbelt. S : s.n.

AMARANTHACEAE

Celosia trigyna L.
Rather localised weed, especially in Low Country. S : 635,667

*Amaranthus hybridus L. subsp. incurvatus (Timeroy ex Gren. et Godr.) Brenan var. cruentus (L.) Mansf.
Infrequent weed of disturbance. S : 267

*A. spinosus L.
Infrequent weed of disturbance. Pan-tropical. S : 644

*Amaranthus sp., cf. A. hybridus L.
Infrequent weed of disturbance. S : 643

Cyathula cylindrica Moq.
Soft low scrambler in scrubby gallery forest. S : 348

C. uncinulata (Schrad.) Schinz
Herbaceous low scrambler in scrubby vegetation. Localised, especially in disturbed sites. S : 332

Achyranthes aspera L.
Sprawling suffrutescent herb. Pan-tropical weed of disturbance. S : 164

Alternanthera sessilis (L.) DC.
Lax herb. Rather rare in early stages of hydrosere. S : 168

Gomphrena celosioides Mart.
Low herb. Widespread weed of disturbance. S : 333

PHYTOLACCACEAE

Psammotropha myriantha Sond.
Low herb of sandy gravelly soil. Disturbed and retarded mesoclinal lithoseral sour grassveld, Mistbelt. Very localised to locally ff. S : 857

*Phytolacca americana L.
Introduced weed of disturbance. Very localised. S : 895

CARYOPHYLLACEAE

*Stellaria media Cyrill
Lax annual herb. Now practically cosmopolitan temperate weed. Rather localised to locally ff. in shady, damp and cool disturbed places. S : 447

Drymaria cordata (L.) Willd. ex Roem. et Schult. subsp. diandra (Blume) J. Duke
Widespread weed of disturbance of moist shady places.
Very localised to locally ff. S : 68

Polycarpaea corymbosa Lam.
Small herb. Widespread weed of cultivation. Localised here. Pioneer on disturbed grassveld of secondary psammosere, L.S.B.T. S : 971

*Corrigiola littoralis L.
Adventive pioneer herb on moist alluvial sandbank. S : s.n.

Silene burchellii Otth
Variable herb. Very localised. Weed of disturbance. S : s.n.

S. capensis Otth
Lax forb. Fairly widespread but rather localised to occ. locally ff. weed of disturbed, retarded grassveld. S : 878

NYMPHAEACEAE

Nymphaea capensis Thunb.
Localised pioneer of hydrosere in still water. Now rr. S : 1

RANUNCULACEAE

Knowltonia transvaalensis Szysz.
Rosette forb with perennial rhizome. Locally ff. in Mistbelt xeroseral grassveld. S : 775

Clematis brachiata Thunb.
Widespread liane in seral and climax communities. S : 279

C. oweniae Harv.
Less frequent liane in Low Country. S : 293

Ranunculus multifidus Forsk.
Small herb of wet places, especially where disturbed. Widespread but localised to locally ff. S : 94

Thalictrum rhynchocarpum Dill. et Rich.
Robust perennial herb. Rather localised. Wet, shady, cool sites in high forest, kloof forest etc. S : 1099

MENISPERMACEAE

Stephania abyssinica (Dill. et Rich.) Walp.
Widespread slender soft twiner. Especially in early scrubby seral stages, especially of hydrosere. S : 135,149

Cissampelos torulosa E.Mey. ex Harv.
Widespread rather infrequent to occ. locally ff. soft twiner in seral grassveld, scrub and woodland. S : 298

ANNONACEAE

Annona senegalensis Pers.
Low tree in open or understory, savanna and scrub, Low Country. S : 778

MONIMIACEAE

Xymalos monospora (Harv.) Baill.
Rather small to medium-sized tree. Rather localised to locally c. to a., in margin, canopy and understory of high forest. S : 987,991

LAURACEAE

Ocotea viridis Kostermans
Fair-sized to large tree. Localised, singly or in widely scattered clumps in high forest. S : 1160

Cryptocarya liebertiana Engl.
High-forest tree of canopy and margin. Locally ff. to (co-) dominant. S : 755

Cassytha ciliolata Nees
Widespread characteristic hemi-parasitic twiner in scrubby vegetation. S : 114

CRUCIFERAE

*Lepidium bonariense L. [= L. ruderale L.]
Locally frequent weed of cultivation especially on moist, shady sites. S : 448

*L. virginicum L. [= L. divaricatum Sond. subsp. linoides (Thunb.) Thell.]
Short-lived herb. Locally frequent weed of cultivation and secondary psammosere, L.S.B.T. Localised. S : 808

Cardamine africana L.
Weed of moist, shady disturbed places, e.g. forest paths. S : 1103

CAPPARIDACEAE

Cleome monophylla L.
Weed of disturbance especially in Low Country. Widespread in Africa and Asia. S : 95

Maerua cafra (DC.) Pax
Small tree. Very localised. Especially along edge, Marginal-Mistbelt forest and scrub forest. S : 1167

DROSERACEAE

Drosera dielsiana Exell et Laundon
Small insectivorous herb. Localised. Hydrolithosere, L.S.B.T. S : 1004

CRASSULACEAE

Kalanchoe rotundifolia Harv.
Widespread succulent herb. Mistbelt and Low Country lithosere. Also epiphytic. S : 338,422

K. thyrsiflora Harv.
Widespread Southern African succulent herb. Here very localised to locally ff. in xeroclinal lithosere, Mistbelt. S : 1146

Crassula muscosa L.
Small subsucculent bush of Mistbelt lithosere. Localised. S : 1127

C. parvisepala Schonl.
Succulent shrublet of Mistbelt lithosere. Localised. S : 950

C. rubicunda E.Mey. ex Harv.
Succulent rosette plant of lithosere especially in Mistbelt. S : 613

C. thorncroftii Burtt Davy
Mat-forming subsucculent herb of moist, shady places. S : 230

Crassula sp., aff. C. nodulosa Schonl.
Subrosulate succulent herb. Localised. Summit Mistbelt lithosere. S: 949

SAXIFRAGACEAE

Choristylis rhamnoides Harv.
Sprawling or subscandent shrub or small tree of forest, scrub forest, forest margins and gallery forest. S : 363

PITTOSPORACEAE

Pittosporum viridiflorum Sims
Small to medium-sized tree. Widespread but scattered, especially in scrub forest. Important forest precursor in Mistbelt.
Keet: 1736; S : 432,511

HAMAMELIDACEAE

Trichocladus ellipticus Eckl. et Zeyh.
Small understory tree. Localised and rr. In riparian forest, Mistbelt, extending just into Low Country in gallery forest. S : 783

ROSACEAE

Rubus pinnatus Willd.
Widespread scrambler. Locally ff., especially in more mesophytic scrubby vegetation. S : 134

Rubus sp.
Sprawling shrub. Especially in Mistbelt. Rather infrequent to locally ff. to abundant weed of moister sites, especially where disturbed. S : 750

Alchemilla rehmannii Engl.
Herb of moist disturbed places and earlier stages of hydrosere. S : 658

Agrimonia odorata Mill. [= A. eupatorium L.]
Subwoody herb. Weed of disturbance especially near water. S : 212

Leucosidea sericea Eckl. et Zeyh.
Very localised small tree. Locally c., Piesang Kop summit; Mistbelt. S : 1021

Cliffortia nitidula (Engl.) R.E. et T.C.Fr. var. pilosa Weim.
Widespread. Rr. ericoid shrub especially along streamsides. S : 767

Prunus africana (Hook.f.) Kalkm. [= Pygeum africanum Hook.f.]
Fair-sized to large canopy and overstory tree of high forest and gallery forest, especially in Mistbelt. Widely scattered, infrequent. S : 959

Parinari curatellifolia Planch. ex Benth. subsp. mobola (Oliv.) R.Graham
Fair-sized tree. Locally ff. to (co-) dominant or subdominant in xeroseral, subseral and climax scrub, scrub forest and Low Country savanna and savanna woodland. S : 439,513

CONNARACEAE

Cnestis natalensis Planch. et Sond.
Robust woody liane in Mistbelt forest and scrub forest, and also in kloofs below the Mistbelt. S : 997

LEGUMINOSAE

Albizia versicolor Welw. ex Oliv.
Small to medium-sized tree. Localised, rr. relicts of Low Country vegetation. S : s.n.

Acacia ataxacantha DC.
Woody scrambler. Widespread. Important to dominant in scrub and scrub forest, forming thickets. Keet: 1745; S : 8

A. caffra (Thunb.) Willd.
Small tree. Localised. River valleys, L.S.B.T. S : 1162

A. davyi N.E.Br. apud Burtt Davy
Small tree. Widespread. Seral scrub and L.S.B.T. S : 231,560

A. karroo Hayne
Small to medium-sized tree. Infrequent to locally abundant in (hydro-) seral scrub and L.S.B.T. savanna (woodland). S : 1095

A. sieberiana DC. var. woodii (Burtt Davy) Keay et Brenan
Medium-sized tree. Fairly widespread but rather localised. S : 754

Dichrostachys cinerea (L.) Wight et Arn. subsp. nyassana (Taub.) Brenan
Widespread small tree. Infrequent to locally ff. in seral grassveld and scrub, especially in Low Country. S : 50

Entada spicata (E.Mey.) Druce
Robust liane of Mistbelt scrub forest and high forest. S : 812,958

Bauhinia galpinii N.E.Br.
Ornamental woody scrambler in seral grassveld, scrub, low scrub forest and savanna (woodland) in Low Country. S : 125

B. kirkii Oliv.
Localised creeper especially in Low Country. S : 119,979

Piliostigma thonningii (Schum.) Milne-Redhead
Shrub or small tree of L.S.B.T. Only isolated relics remain locally. S : 1195

Cassia absus L.
Pan-tropical weed of cultivation and disturbance. S : 891

*C. didymobotrya Fresn.
Adventive garden escape in Low Country. S : 670

*C. laevigata Willd.
Naturalised shrub. Widespread and common especially in the moister disturbed sites. S : 13

C. mimosoides L.
Widespread small subwoody forb of seral grassveld. S : 54

C. occidentalis L.
Widespread in tropics. Soft shrubby plant of disturbance, priseral and subseral sites, especially in Low Country. S : 208

C. petersiana Bolle
Widespread shrub especially of earlier stages of seral scrub and scrub forest, pioneer in grassveld etc. Keet : 1721; S : 198,346

Pterolobium exosum (Gmel.) Bak.f.
Scrambler climbing by hook-thorns. Localised to locally common in relics of L.S.B.T. vegetation (Ridge Variant). S : 1154

*Caesalpinia decapetala (Roth) Alston
Aggressive spiny exotic scrambler. Very troublesome in places. S : 344

Peltophorum africanum Sond.
Rather small spreading tree. Rather infrequent in L.S.B.T.; also a L.S.B. element in xeroclinal lithosere, Mistbelt. S : 821

Calpurnia aurea (Ait.) Benth. [= C. subdecandra (L'Hérit.) Schweick.]
Small tree. Fairly widespread but localised to locally ff. in high forest and Marginal-Mistbelt forest and scrub forest margins. S : 1024

Lotononis eriantha Benth.
Subwoody herb. Very localised in fire-retarded grassveld, Low Country. S : 699

Pearsonia aristata (Schinz) Duemmer
Subwoody suffruticose perennial of Mistbelt lithosere. Rather localised, infrequent to locally ff. S : 1057

P. atherstonei Duemmer
Subwoody bushy herbaceous perennial of retarded grassveld, especially in Low Country. Rather localised. Infrequent to locally ff. S : 466

Crotalaria australis Bak.f.
Locally adventive. Widespread weed of disturbance. S : 905

C. distans Benth.
Suffrutescent herb of disturbed sites. S : 227

C. lanceolata E.Mey.
Herb of disturbed situations, weed of cultivation. S : 201,211

C. mucronata Desv.
Weed of disturbed sites. S : 209

C. natalitia Meisn.
Half-shrubby weed of disturbed sites. S : 308

C. recta Steud.
Weed of disturbed sites. S : 232,295

Argyrolobium adscendens Walp. [= A. longipes N.E.Br.]
Small subwoody herb of early xerosere and subsere in Mistbelt. S : 912

A. harveyanum Oliv.
Small weak-stemmed perennial herb scattered in tussocky N.E. Mtn. Sourveld, top of Escarpment. S : 481

A. tomentosum (Andr.) Druce
Soft, subwoody undershrub of openings in forest (Mistbelt) and gallery forest. Keet : 1724; S : 339,351

A. transvaalense Schinz
Suffrutescent forb of retarded grassveld especially in Low Country. S : 474

*Trifolium pratense L.
Small pasture forb. Very localised. Introduced in mixed planted pasture in Low Country. Not thriving. S : 184

Indigofera adenioides Bak.f.
Very localised suffrutescent bush of xeroclinal lithosere, Mistbelt. S : 1145

I. arrecta Hochst.
Small soft shrub. Infrequent in moist or disturbed places. S : 203

I. fastigiata E.Mey.
Small subwoody forb. Widespread but infrequent in sour grassveld. S: 574

I. garckeana Vatke
Small shrub in N.E. Mtn. Sourveld. Rather localised. S : 1131

I. hilaris Eckl. et Zeyh.
Subwoody perennial forb. Locally frequent in retarded grassveld. S : 467

I. oxalidea Welw. ex Bak.
Prostrate forb of bared ground. Very localised in L.S.B.T. S : 1152

I. ripae N.E.Br.
Small suffruticose forb locally ff. in N.E. Mtn. Sourveld. S : 887

I. sanguinea N.E.Br.
Subwoody forb of retarded grassveld. S : 506

I. schinzii N.E.Br.
Widespread herb of disturbed areas. S : 73, 137, 187, 228

I. swaziensis H.Bol.
Small shrub in scrubby xeroclinal lithoseral sour grassveld.
Localised; in Mistbelt. S : 1151

I. tristoides N.E. Br.
Small shrub. Very localised, on disturbed moist spots. S : 131

I. vicioides Jaub. et Spach.
Small suffruticose forb. Very localised. In mown grass sward. S : 179

Psoralea wilmsii Harms.
Small shrub. Infrequent and localised to locally ff. in N.E. Mtn. Sourveld of summits in Middle and Upper High Forest Zones. S : 712

Tephrosia macropoda (E.Mey.) Harv.
Lax forb with woody rootstock. Fairly widespread but rather localised. In disturbed, retarded, sour grassveld. S : 1018

T. polystachya E.Mey.
Soft short-lived suffrutescent forb. Rather localised and infrequent. Especially in disturbed areas in Low Country. S : 128

T. shiluwanensis Schinz
Robust suffrutescent forb. Widespread. Ff. in earlier seral stages: grassveld to scrubby vegetation. Keet: 1741;S : 74,161

T. tzaneenensis H.Forbes
Lax forb with woody rootstock. Rather localised to occ. locally ff. in disturbed retarded grassveld in Low Country. S : 469

T. zombensis Bak.
Robust shrubby forb. Rather localised to occ. locally ff., especially in disturbed places and retarded grassveld, in Mistbelt. Keet: 1749;S: 341,357

Sesbania macrantha Welw. ex Phill. et Hutch. var. levis Gillett
Robust shrub. Fairly widespread but very localised to occ. locally ff., especially in moist and disturbed places. S : 374,624

Astragalus atropilosulus (Hochst.) Bunge subsp. burkeanus (Harv.) Gillett var. burkeanus
Weedy herb of disturbed places. Very localised here. S : 1165

Aeschynomene nyassana Taub.
Subwoody forb. Infrequent in retarded grassveld in Low Country. S : 683

A. rehmannii Schinz var. leptobotrya (Harms ex Bak.f.) Gillett
Suffrutescent forb. Rather localised and infrequent to locally ff. especially in N.E. Mtn. Sourveld. S : 886

Stylosanthes mucronata Willd.
Subwoody suffruticose forb. Localised, infrequent. In secondary psammoseral grassveld and lithoseral grassveld of rock mat formation, L.S.B.T. S : 1091

Zornia capensis Pers.
Low perennial herb. Rather localised and infrequent to locally ff. on disturbed, bared sites, especially in Low Country. S : 604

Desmodium barbatum (L.) Benth. var. dimorphum (Welw. ex Bak.) Schubert
Suffrutescent forb of disturbed seral grassveld and psammosere in Low Country. Localised to locally ff. S : 241

D. hirtum Guill. et Perr.
Lax to prostrate subwoody forb in N.E. Mtn. Sourveld. S : 581

D. natalitium Sond.
Lax suffrutescent forb in seral grassveld and scrub, L.S.B.T. Localised. S : s.n.

D. repandum (Vahl) DC.
Lax undershrub in undergrowth of moist places in gallery forest, scrub forest and high forest (where disturbed). S : 248

Pseudarthria hookeri Wight et Arn.
Widespread robust shrubby forb of grassveld and scrub. Ff. S : 106,320

Alysicarpus rugosus (Willd.) DC.
Rr. suffruticose forb of disturbed grassveld, especially at low altitudes. S : 176

Dalbergia armata E.Mey.
Robust liane of gallery and riverine scrub, scrub forest and forest. S : 172;749

Pterocarpus angolensis DC.
Fair-sized timber tree of spreading habit. Few large trees remain. Ff. in Low Country. S : 498

P. rotundifolius (Sond.) Druce
Fair-sized spreading tree. Ff. in Low Country. S : 1073

Abrus fruticulosus Wall. ex Wight et Arn.
Slender subwoody twiner. Widespread in scrub and L.S.B.T. savanna and woodland. S : 545

Dumasia villosa DC.
Widespread but rather localised soft twiner of damp shady places, especially in gallery forest. S : 609

Glycine javanica L.
Trailing or twining herbaceous perennial. In grassveld and woodland, especially in Low Country. S : 210,243

Erythrina latissima E.Mey.
Rare stranger or relic in Mistbelt. Fair-sized tree. S : 1171

E. lysistemon Hutch.
Widespread locally ff. tree, especially in scrub and gallery forest. S : 429

Mucuna coriaceae Bak.
Robust soft perennial twiner. Ff. to locally common in Low Country grassveld, scrub, savanna and savanna woodland. S : 123,218

Canavalia virosa (Roxb.) Wight et Arn. [= C. ferruginea Piper]
Herbaceous twiner, Low Country valleys near streams. S : 223,378

*Cajanus cajan (L.) Millsp.
Exotic soft shrub. Cultivated for sake of edible seeds. S : 654

Rhynchosia albiflora (Sims) Alston [= R. cyanosperma Benth. ex Bak.]
Robust subwoody soft twiner. Rather sparsely scattered to occ. locally ff. in Low Country. S : 722

R. angulosa Schinz
Suffruticose forb with woody rootstock. Localised. Summit and xeroclinal broken lithoseral grassveld, Mistbelt. Infrequent to locally ff. S : 1014

R. caribaea (Jacq.) DC.
Widespread slender twiner. Ff., especially in scrubby vegetation. S : 175,367

R. clivorum S.Moore
Soft shrub of rank to scrubby grassveld in Mistbelt. Rather localised to locally ff. and important in succession. S : 360

R. hirsuta Eckl. et Zeyh.
Small perennial soft twiner. Localised and infrequent. Especially subseres, Low Country. S : 1038

R. komatiensis Harms
Suffruticose forb of disturbed or retarded, rank to scrubby grassveld, Low Country to Mistbelt xerocline. S : 496

R. monophylla Schltr.
Herbaceous creeper with woody rootstock. Localised. Occ. locally ff. Retarded grassveld, Low Country and broken lithosere, Mistbelt. S : 693

R. nervosa Benth. et Harv.
Slender twiner. Very localised and infrequent in retarded grassveld, Low Country. S : 751

R. sordida (E.Mey.) Schinz
Slender suffruticose forb. Very localised and infrequent. In early Low Country subsere. S : s.n.

R. totta (Thunb.) DC.
Very slender small twiner. Sparsely scattered in retarded grassveld, Low Country. S : 1049

Eriosema burkei Benth.
Widespread but infrequent forb of retarded grassveld, Low Country to Mistbelt. S : 488

E. cordatum E.Mey. var. gueinzii Harv.
Widespread to locally ff. forb of retarded grassveld, Low Country to Mistbelt. S : 487

E. polystachyum Bak.
Suffrutescent forb of N.E. Mtn. Sourveld. Very infrequent. S : 814

E. psoraleoides (Lam.) G.Don
Widespread suffrutescent forb of disturbed, early seral grassveld, especially in Low Country. S : 112,141

Flemingia grahamiana Wight et Arn.
Large suffrutex invading grassveld. Locally f. in Low Country and especially Mistbelt. Keet : 1759;S : 672

Vigna triloba (Thunb.) Walp.
Small soft twiner. Fairly widespread but rather restricted to grassveld and early scrub stages in Low Country. S : 158,159

V. vexillata Benth.
Small soft twiner. Fairly widespread but rather restricted to grassveld and early scrub stages especially in Low Country. S : 75

V. vexillata Benth. var. hirta (Hook.) Bak.
Small, soft, slender twining creeper. Rather localised. In disturbed, retarded grassveld, especially in Low Country. S : 1194

Vigna sp.
Small soft twiner. Very localised and rr. In plantations, Low Country. S : 143

Vigna sp.
Small but robust creeping forb. Very localised and rare. On termitarium, Low Country. S : s.n.

Dolichos lablab L.
Herbaceous twiner. Widely distributed, infrequent. S : 296

GERANIACEAE

Monsonia biflora DC.
Small herb of disturbed and secondary psammoseral sites, Low Country. Very localised to locally common. S : 791

Pelargonium alchemilloides (L.) Ait.
Low spreading to trailing open herbaceous perennial bush of disturbed grassveld, summit of Piesang Kop, Mistbelt. Localised. S : 1232

P. alchemilloides (L.) Ait. forma
Small rosette herb from perennial rootstock. Very localised: disturbed mesoclinal rocky grassland, Mistbelt. S : 1177

P. luridum (Andr.) Sweet
Rosette plant with perennial rootstock. Widespread forb especially of disturbed grassveld. Localised to locally ff. S : 145

P. multicaule Jacq.
Low spreading herbaceous subwoody perennial bush. Very localised on Marginal Mistbelt xerocline. S : 1074

OXALIDACEAE

*Oxalis corniculata L.
Lax to prostrate herb. Cosmopolitan weed of disturbance. Infrequent to locally ff. S : 543

O. depressa Eckl. et Zeyh.
Very small herb. Between tall tufted grasses, retarded grassveld in Low Country. Very localised to locally ff. S : 526

O. obliquifolia Steud. ex Rich.
Small herb of rock mat formation, xeroclinal lithosere, Mistbelt. Very localised to locally fairly common. S : 1197

O. semiloba Sond.
Widespread weed of cultivation and disturbance. Locally ff. to abundant. S : 40, 290, 337

RUTACEAE

Fagara capensis Thunb.
Rare small tree in rocky retarded scrubby grassveld in Mistbelt. S : s.n.

F. davyi Verdoorn
Widespread tree of high forest and forest margin, Mistbelt. S : 1040

Calodendron capense Thunb.
Fair-sized tree of high forest and forest margin. S : 1075

Vepris undulata (Thunb.) Verdoorn
Small tree. Very localised and infrequent, rather gregarious. Rare precursor and component of high forest. S : 1176

Toddalia asiatica (L.) Lam.
Robust scrambling liane. Very localised, locally ff. L.S.B. element in summit and xeroclinal Marginal-Mistbelt scrub forest and forest. S : 1076

Teclea natalensis Engl.
Small understory tree. Rather localised and infrequent. In high forest. Occ. locally ff. as transgressive, rr. as fully grown tree.
Scheepers & Joynt : S K F 1492

Clausena anisata (Willd.) Hook.f.
Small tree in undergrowth or along margin of high forest and scrub forest in Mistbelt. S : 730

MELIACEAE

*Cedrela toona Roxb. et Rottb.
Exotic ornamental timber tree. Escape from cultivation. S : 734

Ekebergia capensis Sparm. [= E. meyeri Presl]
Small tree. Rather localised to occ. locally ff., especially in scrub forest of south- to east-facing slopes of Piesang Kop. S : 739

Trichilia dregeana Sond.?
Fair-sized to large canopy or occ. overstory tree. Occ. in early stages to sometimes codominant in high forest, especially in rocky places. Mistbelt. S : 1042

T. emetica Vahl ?
Medium-sized canopy or occ. overstory tree. Occ. in savanna woodland and gallery forest, Low Country. S : 358,1234

MALPIGHIACEAE

Sphedamnocarpus galphimiifolius (Juss.) Szysz.
Perennial slender subwoody liane. Fairly widespread but rather localised, especially in scrub, scrub forest, scrubby gallery forest and savanna (woodland). S : 571

POLYGALACEAE

Polygala albida Schinz
Small herb of disturbed sites in Low Country. Very infrequent and localised to locally ff. S : 233

P. amatymbica Eckl. et Zeyh.
Small herb. Locally f. (gregarious) in disturbed sites. S : 1035

P. virgata Thunb.
Widespread suffrutescent forb of disturbed places, and scrubby grassveld. Infrequent to locally ff. Keet : 1722, 1723; S : 294

P. wilmsii Chod.
Small tufted forb of disturbed and retarded sour grassveld, Mistbelt. Very localised to locally ff. and gregarious. S : 1108

EUPHORBIACEAE

Andrachne ovalis Muell. Arg.
Shrub of scrubby forest undergrowth, forest margin or forest precursor in N.E. Mtn. Sourveld. S : 818

Securinega virosa (Roxb. ex Willd.) Pax et Hoffm.
Shrub. Very localised and rare in Low Country. L.S.B. element. S : 1050

Phyllanthus burchellii Muell Arg.
Small herb of disturbed and subseral grassveld and weed of cultivation. S : 85

P. meyerianus Muell. Arg.
Suffrutescent forb of moist to saturated sites, especially where disturbed. S : 192

P. nummulariaefolius Poir.
Subwoody forbs of grassveld and scrub. Widely scattered. S : 82

Drypetes gerrardii Hutch.
Very localised small to medium-sized tree. In small consocies on xeroclinal talus slopes, kloofs, lower Mistbelt zones. S : 1248

Antidesma venosum E.Mey ex Tul.
Usually low spreading tree favouring moist situations. S : 237, 541, 542

Bridelia micrantha (Hochst.) Baill.
Fair-sized tree. Important in seral and climax communities below Mistbelt. S : 573,723

Croton sylvaticus Hochst.
Fair-sized tree. Rather localised to locally ff. in high forest and forest margins. S : 1027

Adenocline mercurialis Turcz.
Soft undershrub in scrubby riverine and kloof forest in Mistbelt. Localised, infrequent. S : 398,437

Leidesia procumbens (L.) Prain [= L. capensis Muell.Arg.]
Small soft herb of open, disturbed, moist parts of high forest, Very localised to locally ff. to common, gregarious. S : 589

Acalypha ciliata Forsk.
Short-lived herb. Localised weed of disturbance, Low Country. S : 331,879

A. petiolaris Hochst.
Subwoody forb. Widespread. Weed of disturbance. S : 76

A. punctata Meisn. apud Krauss
Subwoody forb. Early seral stages, especially Low Country. S : 725,764

A. schinzii Pax [= A. depressinervia (O.Ktze.) K.Schum.]
Subwoody forb. Early seral stages N.E. Mtn. Sourveld. S : 1015

A. segetalis Muell. Arg.
Short-lived herb. Localised weed of disturbance. Low Country. S : 568

A. wilmsii Pax ex Prain et Hutch.
Subwoody forb. Scattered. N.E. Mtn. Sourveld. S : 1060

Tragia rupestria Sond.
Small soft slender twiner or creeper with perennial woody rootstock. Rather localised and infrequent to occ. locally ff. in retarded grassveld, in Low Country. S : 828

Ctenomeria capensis (Thunb.) Harv. et Sond. [= C. cordata Harv.]
Slender soft twiner in undergrowth of scrub, scrub forest and high forest, Mistbelt. S : 786

Sphaerostylis natalensis (Sond.) Croizat [= Tragiella natalensis (Sond.) Pax et Hoffm.]
Perennial slender twiner. Very localised and rare subtropical element, Marginal-Mistbelt transition from scrub forest to high forest. S : 1045

Clutia affinis Sond.
Soft shrub or suffrutex. Infrequent to locally ff. in Mistbelt and moist places in Low Country. S : 116

C. monticola S.Moore
Widespread subwoody herb of seral and retarded grassveld. S : 472,688

Suregada procera (Prain) Croizat
Small tree in understory of gallery forest in Scrub Forest Belt. Very localised and rare. On permanently moist, shady and cool bank. S : 782

*Euphorbia chamaesyce L.
Widespread weed of disturbed bared earth. S : s.n.

*E. geniculata Orteg.
Locally common weed of cultivation and disturbance. S : 569

*E. heterophylla L.
Localised weed of disturbance. Garden escape. S : 564

E. hirta L.
Widespread locally common weed of disturbance and cultivation. S : 151

E. kraussiana Bernh.
Small herbaceous perennial. Undergrowth of Mistbelt forest and margins. S : 400

E. striata Thunb.
Localised forb in N.E. Mtn. Sourveld (summit). S : s.n.

E. trichadenia Pax forma
Forb in retarded, disturbed grassveld, Low Country. S : 1031

ANACARDIACEAE

Sclerocarya birrea (A.Rich.) Hochst.
Medium-sized tree. Very localised relic of former L.S.B.T. vegetation. L.S.B. element. S : 1169

Harpephyllum caffrum Bernh.
Rr., very localised canopy tree. Mistbelt scrub forest and high forest. S : 1098

Lannea discolor (Sond.) Engl.
Small tree of xeroclinal lithosere in Mistbelt (rain shadow) to Low Country on steep, xeroclinal and rocky places. S : 1170

L. edulis (Sond.) Engl.
Low woody forb. Widespread to locally ff. in retarded grassveld, especially in Low Country. S : 682

Protorhus longifolia (Bernh.) Engl.
Small to fair-sized tree of open scrub forest and forest, Mistbelt. Very localised and rare here. S : s.n.

Rhus chirindensis Bak.f. forma legatii (Schonl.) R. et A.Fernandes
[= R. legatii Schonl.]
Rather small to fair-sized tree of Mistbelt scrub, scrub forest and high forest (especially sub-climax), and forest margins. Forest precursor. S : 701

R. intermedia Schonl.
Widespread shrub or small tree of scrub, scrub forest and forest margins. Important in both xerosere and hydrosere. S : 90

R. rehmanniana Engl.
Straggling shrub or small tree. Very infrequently scattered in grassveld and scrub in Mistbelt. S : 1117

R. transvaalensis Engl.
Widespread shrub or small tree. Rather infrequently scattered to occ. locally ff., especially in scrubby veld, Low Country. S : 497,556

AQUIFOLIACEAE

Ilex mitis (L.) Radlk.
Widespread waterside tree. Very localised to infrequent. S : 252,772

CELASTRACEAE

Maytenus heterophylla (Eckl. et Zeyh.) N.Robson
Variable small tree. Widespread. Infrequent in scrubby vegetation. S : 494,696

M. mossambicensis (Klotzsch) Blakelock var. mossambicensis
Small tree of forest margins and undergrowth especially in Mistbelt. S : 414

M. mossambicensis (Klotzsch) Blakelock var. rubra (Harv.) Blakelock
Apparently also occurs at altitudes upwards of about 1,350 m. S : s.n.

M. peduncularis (Sond.) Loes.
Small to fair-sized tree of undergrowth and margin of forest, scrub forest and gallery forest. Infrequent to locally dominant in Mistbelt lithoseral scrub forest on rocks and boulders. S : 359

M. undata (Thunb.) Blakelock
Small tree of margin and undergrowth of high forest and gallery forest. Very localised. Also scrub forest and forest precursor in lithosere, Mistbelt. S : 1148

Catha edulis (Vahl) Forsk.
Widespread rather small tree. Infrequent on the whole to locally a., gregarious. On disturbed, priseral and subseral sites. Keet : 1720; S : 663

Cassine eucleaeformis O.Ktze.
Infrequent rather small tree of high forest (margin). S : s.n.

C. papillosa (Eckl. et Zeyh.) O.Ktze
Rather infrequent, rather small tree of high forest. S : 675

HIPPOCRATEACEAE

Hippocratea nitida Oberm.
Vigorous liane in Mistbelt high forest on rocky sites. Localised. S : 720

ICACINACEAE

Apodytes dimidiata E.Mey ex Arn.
Small to medium-sized tree of Mistbelt forests, forest margin and scrub forest. S : 883

Pyrenacantha grandiflora Baill.
Thick-branched scrambling and twining lianoid or trailing and ascending to erect woody shrub of high forest. Localised to locally ff., high forest and margin, Marginal-Mistbelt forest and scrub forest. S : 1174

SAPINDACEAE

Cardiospermum halicacabum L.
Slender soft twiner. Mainly earlier stages of succession of Low Country. S : 127

Allophylus transvaalensis Burtt Davy
Small tree. Forest precursor and forest margin and understory component. Widespread. S : 859

*?Dodonaea viscosa (L.) Jacq.
Small tree. Native? Pan-tropical escape from cultivation. S : 410,440

MELIANTHACEAE

Bersama sp., cf. B. transvaalensis Turrill
Fair-sized tree of forest and forest margin in Mistbelt. S : 1062

Greyia radlkoferi Szysz.
Large shrub or small tree. Chasmophyte of mesoclinal lithosere, Mistbelt. S : 427

BALSAMINACEAE

Impatiens duthieae L.Bol.
Locally ff., especially near water and in Mistbelt. Soft sub-succulent herb. Rather localised. Infrequent to locally ff. S : 16

I. sylvicola Burtt Davy et Greenway
Soft subsucculent herb. Rather localised. Infrequent to occ. locally ff., especially near water in Mistbelt. Scheepers & Haasbroek:S K F 1097

RHAMNACEAE

Ziziphus mucronata Willd.
Small tree. Widespread but rather localised and infrequent. In scrubby vegetation especially in Low Country. S : 820

Scutia myrtina (Burm.f.) Kurz
Robust woody scrambler or liane. Very localised and infrequent in Mistbelt kloof forest and gallery forest. S : 1087

Rhamnus prinoides L'Herit.
Widespread shrub or scrambler of scrub and scrub forest. Localised to locally ff., especially in moister situations. S : 395

Helinus integrifolius (Lam.) O.Ktze.
Rather small woody liane or scrambler. Low Country to Mistbelt scrubby vegetation. S : 115,365

HETEROPYXIDACEAE

Heteropyxis natalensis Harv.
Small tree. Widespread: in seral and climax Low Country scrub and savanna (woodland); seral in Mistbelt. S : 914

VITACEAE

Rhoicissus revoilii Planch.
Robust woody liane of high forest (especially subclimax) and scrub forest. Rather localised and infrequent. S : 789

R. rhomboidea (E.Mey et Harv.) Planch.
Robust woody liane of high forest and gallery forest. Locally ff. to common, especially in Mistbelt. S : 409

R. tomentosa Lam.
Very robust woody liane of high forest and gallery forest. Widespread. Locally ff. S : 805

R. tridentata (L.f.) Wild et Drummond
Very widespread shrubby plant, sometimes lianoid. Locally ff. to common, especially on disturbed retarded grassveld, especially roadsides and firebreaks. S : 269

Cyphostemma anatomicum (C.A.Sm.) Wild et Drummond
Frequent liane in high forest and kloof forest, Mistbelt. S : 586,587

C. cirrhosum (Thunb.) Descoings subsp. transvaalense (Szysz.) Wild et Drummond
Climbing soft perennial. Widespread, infrequent. S : 285

C. woodii (Gilg et Brandt) Descoings
Subscandent soft perennial forb. Widely distributed, especially in Low Country. S : 72

Cayratia gracilis (Guill. et Perr.) Suesseng.
Slender herbaceous climber in undergrowth of gallery forest to disturbed open woodland in Low Country. Localised. S : 117,608

TILIACEAE

Corchorus tridens L.
Old World Tropics. Widespread herbaceous weed of disturbance. S : 310

C. trilocularis L.
Widespread African herbaceous weed of disturbed sites. S : 311

Sparmannia ricinocarpa (Eckl. et Zeyh.) O.Ktze.
Undershrub. Rather localised to locally ff. in moist cool, lightly shaded places in Mistbelt. Keet : 1739; S : 347,585

Grewia occidentalis L.
Widespread straggly shrub or small tree, sometimes subscandent. Rather infrequent in scrub, scrub forest and forest. S : 804

Triumfetta annua L. forma annua
Variable-sized annual. Widespread but rather localised to locally common weed of disturbance. S : 195, 225, 312

T. pilosa Roth var. effusa (E.Mey ex Harv.) Wild
Fair-sized annual. Rather localised, infrequent to locally ff., especially moister, shadier disturbed sites in Mistbelt. Keet : 1747; S : 247

T. pilosa Roth. var. tomentosa Szysz. ex Sprague et Hutch.
Small to large annual. Widespread locally ff. to common weed of disturbance. Keet : 1748; S : 147,220

T. rhomboidea Jacq.
Small to fair-sized annual. Widespread. Locally ff. to common on disturbed sites. S : 139

T. welwitschii Mast. var. hirsuta (Sprague et Hutch.) Wild
Forb with perennial woody rootstock. Rather localised, locally ff. on disturbed and fire-retarded sour grassveld, especially Low Country. S : 470

MALVACEAE

Abutilon angulatum (Guill. et Perr.) Mast. var. macrophyllum (Bak.f.) Hochr.
Robust herb. Localised weed of disturbance in Low Country. S : 980

A. sonneratianum (Cav.) Sweet
Short-lived herb. Localised weed of disturbance, especially in Low Country. S : s.n.

Malvastrum coromandelianum (L.) Garcke
Widespread suffrutescent ruderal and weed of cultivation. Locally ff. S : 355

*Sida acuta Burm.f.
Suffrutescent forb. Rather localised, infrequent to locally ff. on disturbed sites in Low Country. Central American, now widespread in tropics. S : 276

S. cordifolia L.
Suffrutescent forb. Pan-tropical weed of disturbance. Ff. in disturbed places, especially in Low Country. S : 138

S. dregei Burtt Davy
Slender suffrutescent forb. Localised and infrequent. On disturbed sites, especially in Low Country. S : 908

S. pseudocordifolia Hochr.
Suffrutescent forb. Fairly widespread but rather localised, locally ff. in disturbed places, especially in Low Country. S : 330

S. rhombifolia L.
Widespread suffrutescent forb. Pan-tropical weed of disturbance. Locally ff. to common on disturbed sites. A "forest form" may be recognised in the field (cf. S: 111). S : 110,111

S. triloba Cav.
Small subwoody herb. Very localised and infrequent to locally ff. in disturbed places in high forest, especially roads and paths, where canopy opened. S : 919

Pavonia columella Cav.
Widespread African weed of moister disturbed areas. Keet : 1726; S : 189

Hibiscus altissimus Hornby
Subscandent soft shrubby perennial. Infrequent to locally ff. in open (disturbed) scrub. S : 327;438

H. cannabinus L.
Short-lived pan-tropical herbaceous weed of disturbed sites. Widespread, infrequent to occ. locally ff. S : 300,323

H. meeusei Exell
Robust herbaceous ruderal and weed of disturbance and cultivation, pioneer of subseres, etc. Widespread, infrequent to locally ff. S : 186

H. pedunculatus L.f.
Lax (to subscandent) soft shrub of openings in forest. Very localised and rare. Mistbelt. S : 873

H. physaloides Guill. et Perr.
Widespread African herbaceous weed of disturbance. Localised and rr. Especially in Low Country. S : 633

H. trionum L.
Widespread herbaceous species of Old World tropics. Localised here, in wet places. S : 800

H. vitifolius L. subsp. vitifolius Brenan et Exell
Lax (to subscandent) soft shrub. Localised to occ. locally ff. in moister, shadier disturbed places. S : 249,386

Hibiscus sp., cf. H. aethiopicus L. var. ovatus Harv.
Low subwoody forb of seral rocky grassveld in Mistbelt. Localised to occ. locally ff. on disturbed sites. S : 1067

STERCULIACEAE

Dombeya burgessiae Gerr.
Widespread large shrub or small tree in earlier stages of succession. S : 39,262

D. rotundifolia (Hochst.) Planch.
Small tree. Infrequently scattered in scrub. S : 458

Hermannia cristata H.Bol.
Small subwoody forb. Localised. Disturbed lithoseral grassveld, Mistbelt. S : 1013

H. floribunda Harv.
Rather stiff suffrutex. Rr. to infrequently scattered in scrub. S : 943

H. gerrardii Harv.
Lax suffrutescent forb scattered in grassveld and scrub. S : 213,316

Waltheria indica L.
Suffrutescent forb. Widespread but rather localised, infrequent on disturbed sites especially in Low Country. S : 302

OCHNACEAE

Ochna holstii Engl.
Widespread, small to medium-sized tree of understory, scrub forest and forest margins, Low Country and especially Mistbelt. S : 994

O. o'connorii Phillips
Fair-sized understory and canopy tree, high forest and occ. along scrub forest and forest margins, Mistbelt. Locally ff. to common. S : 728

GUTTIFERAE

Hypericum aethiopicum Thunb. subsp. sonderi (Bred.) Robson
Widespread. Infrequent small subwoody forb of retarded sour grassveld. S : 485

H. lalandii Choisy
Widespread African pioneer and weed of disturbed areas. S : 1093,1116

H. revolutum Vahl
Spreading shrub. Infrequent to locally frequent in Mistbelt glades and along forest margins. Important in succession. Keet : 1727; S :412

VIOLACEAE

Rinorea angustifolia (Thouars) Baill. [= R. natalensis Engl.]
Shrub or small tree of shrub layer and understory of high forest. S : 766

Viola abyssinica Steud. ex Oliv.
Low slender trailing perennial. In rank N.E. Mtn. Sourveld, especially the more disturbed sites. S : 843

FLACOURTIACEAE

Rawsonia lucida Harv. et Sond.
Understory tree of high forest. Locally ff. to common, especially lower altitudes of high forest zones (1200 m - 1500 m). S : 752

Oncoba spinosa Forsk.
Infrequent ornamental shrub. Often cultivated especially in Low Country. Widespread African species extending to Arabia. Keet : 1763; S: 1113

Kiggelaria africana L.
Widespread variable tree especially in upper montane high forest and riverine forest. Infrequent to locally ff. S : 505

Scolopia zeyheri (Nees) Harv.
Small to large tree of scrub, high forest, marginal forest and scrub forest in Mistbelt, where infrequently scattered to locally ff. S : 1069

Homalium dentatum (Harv.) Warb. [= H. subsuperum Sprague]
Rather infrequent. Large canopy and overstory tree of high forest. S : 903

Trimeria grandifolia (Hochst.) Warb.
Small tree. Rather localised to locally ff., especially as understory (occ. canopy) tree in high forest, kloof forest and scrub forest in Mistbelt; also forest margin. Keet : 1760; S : 551,552

Aphloia theiformis (Vahl) Benn.
Shrubby to subscandent small tree. Forest precursor, margin or undergrowth. S : 679

Dovyalis zeyheri (Sond.) Warb.
Small tree in scrub and scrub forest. Infrequent. S : 999

TURNERACEAE

Wormskioldia longepedunculata Mast.
Small herb. Widespread but rather infrequent weed of disturbance especially in Low Country. S : 24

PASSIFLORACEAE

Tryphostemma viride Hutch. et Pearce
Subwoody forb with perennial rootstock. Rather localised, infrequent to occ. locally ff. in fire-retarded sour grassveld, Low Country. S : 760

Adenia digitata (Harv.) Engl.
Widespread herbaceous tendril scrambler with large woody rootstock. Locally ff. in grassveld. S : 23, 515, 516

A. gummifera (Harv.) Harms
Widespread liane, L.S.B.T. to high forest. Infrequent to occ. locally ff. Keet : 1742; S : 744

*Passiflora edulis Sims
Widely naturalised exotic climber. Common escape in plantations and savanna communities. S : 1168

ACHARIACEAE

Ceratiosicyos laevis (Thunb.) A. Meeuse [= C. ecklonii Nees]
Soft twiner in undergrowth of more open riverine and gallery forest. S : 397

BEGONIACEAE

Begonia sonderiana Irmscher
Semisucculent soft subwoody perennial herb of moist shady lithosere. S : 122

THYMELAEACEAE

Peddiea africana Harv.
Shrub or small tree of high forest understory. Locally infrequent to ff. S : 455

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Lasiosiphon caffer Meisn.
Subwoody forb. Rather infrequent in fire-retarded grassveld. Widespread. S : 681

Arthrosolen microcephala (Meisn.) Phill.
Subwoody forb. Rather localised and locally infrequent in fire-retarded sour grassveld. S : 684

Dais cotinifolia L.
Small tree. Localised. Locally abundant, gregarious. In mesoclinal to summit scrub, Mistbelt. S : 811,856

RHIZOPHORACEAE

Cassipourea gerrardii Alston
Characteristic understory or occasionally canopy tree of high forest. S : 765

COMBRETACEAE

Combretum erythrophyllum (Burch.) Sond.
Fair-sized tree. Widespread especially along but also away from streams. S : 464

C. gueinzii Sond.
Usually rather small tree, sometimes lianoid. Widespread in Low Country also in earlier stages in Mistbelt. S : 384,495

C. kraussii Hochst.
Fair-sized tree in Mistbelt scrub, scrub forest and high forest. Forest precursor to climax component. S : 614,753

C. suluense Engl. et Diels
Localised small tree in lithosere, river valleys; L.S.B.T. S : 1133

C. zeyheri Sond.
Very localised small tree: L.S.B. outlier; rain shadow, Piesang Kop. S : s.n.

Terminalia sericea Burch. ex DC.
Small to medium-sized tree. Rather localised and infrequent. In scrub and climax vegetation, L.S.B.T., and rare L.S.B. element in xeroclinal lithosere, Mistbelt. S : 1156

MYRTACEAE

**Psidium guajava* L.
Small tree. Pan-tropical escape from cultivation. Widespread. Locally ff. to common. S : 1179

Eugenia natalitia Sond.
Small tree or shrub. Understory (and margins) of high forest, scrub forest and gallery forest. Keet : 1719; S : 785

Syzygium cordatum Hochst. ex Harv. et Sond.
Widespread medium- to fair-sized tree. Widely scattered, rather infrequent in Mistbelt to locally ff. to dominant on wet sites in Low Country. S : 499

S. gerrardii (Harv.) Hochst.
Fair-sized to large canopy and emergent tree of high forest. Rather localised, locally ff. to dominant in upper and middle high forest and riverine forest. S : 668

S. guineense (Willd.) DC.
Medium-sized tree. Rather localised to very occ. ff. riparian tree of gallery forest in Low Country. S : 1001

MELASTOMATACEAE

Antherotoma naudinii Hook.f.
Minute to small, usually single-stemmed herb of moist places, e.g. seepages. S : 1135

Dissotis canescens (E.Mey ex Grah.) Hook.f.
Suffrutex of earlier stages of hydrosere. Keet : 1758; S : 132

ONAGRACEAE

Ludwigia palustris (L.) Ell.
Lax herb. Widespread pioneer of hydrosere. Very localised, rare. S : 1181

Epilobium salignum Hausskn.
Herbaceous helophytes. Localised to locally ff. S : 625

*Oenothera indecora Cam.
Subwoody weed of disturbance. Locally ff. S : 270

*O. rosea Ait.
Small herbaceous weed of wet, disturbed places. Localised. S : 597

*O. tetraptera Cav.
Subwoody weed of disturbance. Very localised. S : 1102

HALORRHAGIDACEAE

Laurembergia repens Berg.
Small perennial forb in saturated seepages, hydrosere etc. S : 721

Gunnera perpensa L.
Perennial rhizomatous herb. Early hydrosere. S : 1039

ARALIACEAE

Cussonia spicata Thunb.
Widespread small to fair-sized tree of high forest and forest precursor. Ff. to common locally. S : 392

C. umbellifera Sond.
Infrequent to locally ff. tree of Mistbelt mesocline forests. S : 277

UMBELLIFERAE

Hydrocotyle americana L.
Widespread trailing herb of wet places. Localised. Very variable in size. S : 376,936

Centella coriacea Nannfd.
Prostrate herb of moist to wet seral situations. S : 246,534

Sanicula elata Buch. Ham. ex D.Don
Low herb of disturbed floor of high forest, especially paths.
Rather localised to locally ff. S : 591

Alepidea gracilis Dumm. var. major Weimarck
Rr. herb. Localised and gregarious especially in the
moister spots. S : 922

Heteromorpha transvaalensis Schltr. et Wolff
Tall subwoody herbaceous perennial. Rr. to infrequent
in Low Country. S : 171

H. trifoliata (Wendl.) Eckl. et Zeyh.
Small tree mainly of early stages of succession. S : 343

*Apium leptophyllum (Pers.) F.Muell. ex Benth.
Herb. Adventive on sand bank. S : s.n.

Pimpinella transvaalensis Wolff
Variable-sized forb of retarded N.E. Mtn. Sourveld. Localised
to locally ff., disturbed sites. S : 910,913,965

Peucedanum caffrum Phill.
Forb of disturbed xeroclinal Marginal-Mistbelt sites. Very
localised to locally ff. S : s.n.

P. venosum Burtt Davy
Tall herbaceous ruderal. Rr. and localised. Especially
in Scrub Forest Belt. S : 368

Steganotaenia araliacea Hochst.
Small tree. Localised. Rr. relics of L.S.B.T. vegetation.
L.S.B. element. S : 1206

*Lefeburia sp.
Robust perennial herb, especially in plantations. "Probably
introduced" (A.D.J. Meeuse). Infrequent. S : 162,329

CORNACEAE

Curtisia dentata (Burm.f.) C.A.Sm.
Fair-sized tree of high forest and forest margin. S : 832

ERICACEAE

Erica woodii H.Bol. var. robusta Dulfer (Scheepers No. 921 is
the type of the variety)
Low soft shrub. Colonising grassveld and seral scrub in
High Forest Belt. S : 921

MYRSINACEAE

Maesa lanceolata Forsk.
Widespread small tree. Common pioneer of forest, scrub
forest and scrub in grassland. S : 108

Myrsine africana L.
Small twiggy shrub. Locally common to dominant along forest margin and in undergrowth of Curtisia dentata Consocies. Mistbelt. S : 480

Rapanea melanophloeos (L.) Mez
Medium-sized tree of subclimax forest, seral scrub and scrub forest and forest margins. Important forest precursor, in N.E.Mtn. Sourveld. Locally ff. to abundant in Mistbelt. Occ. in high forest. S : 714

PRIMULACEAE

Lysimachia ruhmeriana Vatke
Robust weedy forb especially of wet places. S : 799

SAPOTACEAE

Mimusops zeyheri Sond.
Fair-sized to large tree. In kloofs in Low Country and especially on xerocline in Mistbelt. Localised and infrequent. S : 540,662

EBENACEAE

Euclea crispa (Thunb.) Guerke
Widespread, very variable small tree. Understory and canopy; scrubby grassveld, scrub and scrub forest. Low Country and Mistbelt. S : 345, 1052, 1071

Diospyros lycioides Desf. subsp. sericea (Bernh.) de Wint.
Low shrub. Widespread in earlier stages of succession. Locally a. S : 685

D. whyteana (Hiern.) F.White
Infrequent lax understory tree or shrub in high forest. S : 790

OLEACEAE

Olea capensis L. subsp. macrocarpa (C.H.Wr.) Verdoorn
Fair-sized canopy tree of high forest. Large trees very infrequent (exploitation?). Transgressives may be occ. locally ff. to common. Mistbelt, especially Upper High Forest Zone. S : 1104

Jasminum streptopus E.Mey var. transvaalense (S.Moore) Verdoorn
Small woody twiner. Widespread. Especially in gallery forest and high scrub forest. S : 802

LOGANIACEAE

Strychnos spinosa Lam.
Small tree. Rather localised and infrequent. In Low Country. Occ. locally ff. L.S.B. element in xeroclinal lithosere in Mistbelt as a pioneer chasmophyte (in rain shadow). S : 809

Strychnos sp., cf. S. mitis S.Moore
Small understory tree of Drypetes gerrardii Consocies, talus slopes, xeroclinal cliff forest, Mistbelt. Very localised and rr. S : 1249

Anthocleista grandiflora Gilg
Medium-sized to tall tree. Favours moister situations especially gallery forest, etc; usually at lower elevations. S : 797

Nuxia congesta R.Br. ex Fresn.
Small to fair-sized tree. Infrequent to locally ff. in gallery and riverine forest, scrub forest and scrub, especially in Mistbelt. S : 391

N. floribunda Benth.
Small to fair-sized tree. Infrequent to locally ff. in gallery and riverine forest, high forest, scrub and forest margins especially in Mistbelt. S : 621

Buddleia salviifolia (L.) Lam.
Locally ff. small tree of forest margins or forest precursor. S : 475

GENTIANACEAE

Exacum quinquenervium Griseb.
Very localised. Seepages in crevices in rock. Hydrolithosere. S : 1134

Sebaea grandis (E.Mey.) Steud.
Small saprophytic herb associated with pioneer grasses on bare areas. Infrequently scattered to locally ff. especially in Low Country. S : 130,576

S. leiostyla Gilg
Sprawling perennial forb in grassveld, especially in Low Country. Very infrequently scattered. S : 282

APOCYNACEAE

Acokanthera oppositifolia (Lam.) L.E.Codd
Small tree. Margins in scrubby forest and marginal forest, Mistbelt. Rare here. S : s.n.

Carissa bispinosa (L.) Desf. ex Brenan var. acuminata (E.Mey.) L.E. Codd
Widespread shrub in undergrowth and along margin of forest and scrub forest, especially in Mistbelt. S : 361,748

C. edulis Vahl
Large subscandent shrub or small tree in Low Country and in Mistbelt rain-shadow scrub and scrub forest. S : 1144

*Catharanthus roseus (L.) G.Don [= Lochnera rosea (L.) Reichb.]
Pan-tropical weed and escape from cultivation. S : 565

Rauvolfia caffra Sond.
Fair-sized spreading tree. Localised. Especially in earlier stages of succession in Mistbelt. Also in Low Country, especially near streams. S : 445

Strophanthus speciosus (Ward et Harv.) Reber
Scrambling liane. Rather localised. In High Forest Belt. S : s.n.

ASCLEPIADACEAE

Mondia whitei (Hook.f.) Skeels
Robust liane. Very ornamental. Very rare in Scrub Forest Belt. S : 1058

Cryptolepis capensis Schltr.
Liane in high forest. Infrequently scattered. Especially near margins. S : 1187

C. oblongifolia Schltr.
Subwoody half-twining forb of retarded seral grassveld. S : 1051

Raphionacme hirsuta (E.Mey.) R.A.Dyer
Widespread forb with tuberous rootstock. Rather localised to locally ff. in disturbed, retarded sour grassveld. S : 1023

Xysmalobium acerateoides N.E.Br.
Perennial forb. Localised and rr. in N.E. Mtn. Sourveld. S : 816

X. confusum Scott-Elliot
Robust perennial forb. Localised and rr. in N.E. Mtn. Sourveld. S : 1089

Xysmalobium sp.?, cf. X. orbiculare D.Dietr.?
Forb in Mistbelt scrub. Very localised and rare. S : s.n.

Schizoglossum cordifolium E.Mey.
Small forb of disturbed secondary grassveld sites. Low Country. Very localised and infrequent. S : 697

S. pachyglossum Schltr.
Forb with perennial semi-succulent woody rootstock. Localised and infrequent. In disturbed lithoseral rocky grassveld, Mistbelt. S : 1107

S. pulchellum Schltr.
Slender forb. Very localised and infrequent. N.E. Mtn. Sourveld. S : 1065

Pachycarpus campanulatus N.E.Br.
Erect forb from perennial rootstock. Rr. in N.E. Mtn. Sourveld. S : 964

P. concolor E.Mey.
Erect forb from perennial rootstock. Rr. in N.E. Mtn. Sourveld. S : 1070

Asclepias affinis Schltr.
Rare perennial herb of disturbed seral grassveld on rocky hill-sides, Mistbelt. S : 1068

A. burchellii Schltr.
Herbaceous weed of disturbed dry sites, especially in Low Country. S : 1046

A. fruticosa L.
Weed of disturbed and burnt veld. S : s.n.

A. macra Schltr.
Rare herb of tussocky N.E. Mtn. Sourveld. S : s.n. (PRE)

A. physocarpa Schltr.
Tall weed of disturbed N.E. Mtn. Sourveld. S : 989

Pentarrhinum insipidum E.Mey.
Small soft twiner. Rather restricted to disturbed scrubby grassveld especially in Low Country. S : 14

Cynanchum tetrapterum (Turcz.) R.A.Dyer [= C. sarcostemmatoides K.Schum.]
Leafless succulent twiner. Very localised L.S.B. element of xeroclinal lithosere, Mistbelt, in rain shadow. S : s.n.

Sarcostemma viminale R.Br.
Leafless succulent perennial twiner. Very localised and rr. in L.S.B.T. lithosere. S : 862

Secamone alpinii Schult.
Vigorous slender liane. Ff. to locally common in high forest, less so in forest margins, scrub forest and scrub in Mistbelt and even occ. in scrubby N.E. Mtn. Sourveld. S : 727

S. gerrardii Harv.
Vigorous slender liane. Rather localised. Ff. to locally common in high forest and marginal forest. S : 1026

S. parvifolia (Oliv.) Bullock
Vigorous slender liane. Localised and rr. L.S.B. element, in L.S.B.T. xerosere. S : 1184

Sisyranthus randii S.Moore
Slender forb. Very localised and rather infrequent. Tussocky (summit) N.E. Mtn. Sourveld. S : 845

Brachystelma pygmaeum (Schltr.) N.E.Br.
Small herbaceous perennial of disturbed rocky seral grassveld in Mistbelt. S : 719

Ceropegia barbertonensis N.E.Br.
Small semisucculent soft twiner in Mistbelt. Localised, e.g. in Curtisia dentata Consocies, southern face of Piesang Kop. S : 1200

C. meyeri Decne.
Soft twiner. Rather infrequent in scrub. S : 64

C. setifera Schltr.
Soft twiner of lithosere, L.S.B.T. Localised. S : 1157

Riocreuxia picta Schltr.
Slender subwoody twiner. Localised. In high forest, especially near margin and where canopy thin. Very infrequent. S : 1189

R. torulosa Decne.
Rather slender subwoody twiner. Widespread. Especially in scrub, scrub forest, and occ. in forest where canopy light. Infrequent. S : 561

Gymnema sylvestre (Retz.) Schult.
Widespread liane in Old World tropics. Localised in L.S.B.T. S : 1185

Tylophora flanaganii Schltr.
Slender twining liane. Rather localised, locally ff. to c. to a. in undergrowth of high forest. S : 1188

Tylophora sp. ?, cf. T. anomala N.E.Br. ?
Slender twiner in undergrowth of high forest. Very localised and apparently rr. S : s.n.

Telosma africana N.E.Br.
Subwoody perennial slender twiner. Rather localised, infrequent. In L.S.B.T. savanna woodland and riparian forest. S : 1178

CONVOLVULACEAE

Cuscuta kilimanjari Oliv.
Soft twiner parasitic on soft shrubs and herbs in high forest, especially under openings in canopy. S : 647

Dichondra repens J.G. et R.Forst.
Prostrate herb colonising bare, moist and often disturbed areas. S : 256

Convolvulus farinosus L.
Apparently indigenous, soft twiner of earlier stages of succession. S : 325

Hewittia sublobata (L.f.) O.Ktze.
Infrequent soft creeper of roadsides, damp or shady places. S : 257,324

Ipomoea arachnosperma Welw.
Small creeper in Low Country. Rr. S : s.n.

I. cairica (L.) Sweet
Infrequent perennial creeper in grassveld and scrub especially where disturbed. S : 961

I. crassipes Hook.f.
Rather infrequent perennial forb in seral grassveld in Low Country. S : 825

I. eriocarpa R.Br.
Herbaceous creeper. Infrequent ruderal in Low Country. S : 234

I. obscura (L.) Ker-Gawl. var. fragilis (Choisy) A.Meeuse
Widespread herbaceous twiner in grassveld and scrub. S : 206,217

I. papilio Hall.f.
Herbaceous creeper in Low Country. Rather infrequent. S : 978

I. plebeia R.Br. subsp. africana A.Meeuse
Herbaceous creeper. Rather infrequent ruderal especially in Low Country. S : 183

*I. purpurea (L.) Roth
Introduced twiner. Widespread weed but localised. S : 301

I. wightii (Wall.) Choisy
Widespread and ff. perennial twiner in grassveld, scrub, scrub forest and even forest. Low Country to Mistbelt. S : 319

BORAGINACEAE

Ehretia amoena Klotzsch
Rr. relic on ridges, L.S.B.T. S : s.n.

*?Trichodesma zeylanicum (Burm.f.) R.Br.
Annual weed of disturbance. Widespread in Old World tropics. S : 349

T. physaloides A.DC.
Low bushy forb with perennial rootstock. Very localised and rare here. Rocky xeroclinal retarded sourveld, Marginal Mistbelt. S : 1166

Cynoglossum lanceolatum Forsk.
Widespread weed of cultivation and disturbed areas. S : 87, 219

Myosotis afropalustris C.H.Wr.
Small herb on bare disturbed earth, Low Country. Very localised. S : 823

VERBENACEAE

*Verbena bonariensis L.
Robust subwoody forb. Rather localised. In moist, sunny places. S : 93

*V. officinalis L.
Suffrutescent forb. Fairly widespread but rather localised, infrequent. Especially on disturbed open sites. S : 334

*V. tenuisecta Briq.
Low subwoody forb. Fairly widespread but rather localised, infrequent American ruderal especially along roadsides. S : 15

*Lantana camara L.
Spreading subscandent shrub. Garden escape. Infrequent noxious weed. S : 627

L. mearnsii Moldenke
Low soft shrub. Rather infrequent in scrubby grassveld and scrub. Widespread. S : 144

Lippia javanica (Burm.f.) Spreng.
Widespread shrub. Common ruderal. In scrub and invading grassveld. Keet : 1746; S : 126

Priva meyeri Jaub. et Spach.
Herb of disturbed sites. Localised: very infrequent. S : 522

Clerodendrum glabrum E.Mey.
Widespread but very infrequent to occ. locally ff., especially in Low Country. Shrub or small tree of (disturbed) early scrubby seral stages. S : 848

C. triphyllum Pearson
Low subwoody perennial forb of disturbed early-stage seral and subseral grassveld, especially in Low Country. S : 694

LABIATAE

Teucrium capense Thunb.
Diffuse subwoody forb. Very localised here. In disturbed sites, Low Country. S : s.n.

Leonotis dysophylla Benth.
Soft shrubby perennial. Widespread in earlier stages of succession. S : 280

Leucas martinicensis R.Br.
Pan-tropical weed of cultivation. S : 47

Stachys grandifolia E.Mey.
Soft undershrub. Widespread but rather localised and infrequent. In lightly shaded, damp, cool, often disturbed places. S : 58

S. nigricans Benth.
Slender forb with perennial rootstock. Rather localised, infrequent to occ. locally ff. in retarded sour grassveld in Mistbelt. S : 858

Stachys sp., cf. S. rehmannii Skan
Laxly spreading low forb. Rather localised to locally ff. in summit N.E. Mtn. Sourveld. S : 729

Salvia aurita L.f.
Suffrutescent forb. Very localised to locally ff., gregarious.
Disturbed grassveld bordering Marginal-Mistbelt forest. S : 1109

*S. coccinea L.
Short-lived perennial forb. Widespread, sparsely scattered,
locally ff. to c. exotic weed of disturbance. Keet : 1728; S : 41

Satureia biflora (Buch. Ham. ex D.Don) Briq.
Widespread small perennial forb. Rather infrequent to locally ff. S : 521

Hyptis pectinata (L.) Poit.
Pan-tropical weed of disturbed sites. S : 385

H. spicigera Lam.
Soft suffruticose adventive in swampy situation.
Scheepers & Joynt : S K F 1677

Aeolanthus rehmannii Guerke
Suffrutescent herb. Widespread but localised chasmophyte and
pioneer of bare rock, rock mat formation. S : 932

Endostemon obtusifolius (E.Mey. ex Benth.) N.E.Br.
Widespread soft shrub in rank grassveld, scrub and scrub forest. S : 77, 174

Pycnostachys reticulata (E.Mey.) Benth.
Soft open shrub of moist open places. Localised and infrequent.S : 271

P. urticifolia Hook.
Widespread soft shrub or undershrub of open places, in rocky
places, scrub, scrub forest and gallery forest. S : 273,305

Plectranthus arthropodus Briq.
Soft shrublet of mesoclinal lithosere, Mistbelt. Very localised. S : 1106

P. calycinus Benth.
Herbaceous subwoody perennial forb of N.E. Mtn. Sourveld, often
on disturbed sites. Locally ff. S : 657

P. dolichopodus Briq.
Herbaceous undershrub of disturbed, more open parts of high forest.
Very infrequent but locally common. S : 923

P. fruticosus L'Hérit.
Soft shrub of undergrowth of high forest and gallery forest. Locally
infrequent to often abundant over extensive areas. S : 239

P. laxiflorus Benth.
Soft undershrub of undergrowth in Low Country scrub forest
and gallery forest and rr. pioneer in N.E. Mtn. Sourveld.
Very infrequent and localised. S : 170

P. myrianthus Briq.
Soft perennial undershrub of mesoclinal Mistbelt scrub forest.
Localised and rr. here. S : 972

P. nummularis Briq.
Lax to trailing succulent herb, locally on rocks or occ. as
an epiphyte in gallery forest, L.S.B.T. S : 640

P. swynnertonii S.Moore
Lax undershrub of more open, moister parts of high forest.
Localised to locally abundant. S : 947

P. tomentosus Benth.
Herbaceous perennial chasmophyte of Mistbelt lithosere.
Very localised to occ. locally ff. S : 954

Coleus rehmannii Briq. [= Plectranthus tysonii Guerke]
Soft undershrub of moist shady disturbed or rocky situations
in Mistbelt scrub forest and forest. S : 340,59?

*?C. rotundifolius (Poir.) A.Chev. et Perrot. [= C. dysentericus Bak.]
Herb cultivated by Bantu for its edible root tubers. S : 931

Iboza riparia N.E.Br.
Small soft shrub. Chasmophyte in Mistbelt lithosere and in
deeper soil in Low Country. S : 993

Hemizygia petiolata Ashby
Small suffrutescent bush. Rr. weed of disturbance. S : 387

H. rehmannii (Guerke) Ashby
Rather low, spreading suffruticose bush. Localised, infrequent to locally
ff., especially in disturbed, lithoseral grassveld, Mistbelt. S : 909

Ocimum urticifolium Roth [= O. suave Willd.]
Rather soft open shrublet. Rather localised, occ. locally
ff. in disturbed areas. S : 182

Becium knyanum (Vatke) G.Tayl.
Low subwoody herb of retarded seral grassveld especially
in Low Country. S : 490

SOLANACEAE

*Nicandra physaloides (L.) Gaertn.
Robust weed of cultivation and disturbance, especially in
Low Country. Locally ff. to common. S : 266

*Physalis angulata L.
Low introduced herbaceous weed of disturbance. Localised.
Especially in Low Country. S : s.n.

*P. peruviana L.
Widespread escape, especially of disturbed areas. S : 99

*Capsicum frutescens L.
Pan-tropical escape from cultivation and weed of disturbance.
Rather localised to locally ff. In Low Country. S : 628

Solanum aculeastrum Dun.
Straggling shrub. Very localised and infrequent to occ.
locally ff. ruderal in Mistbelt. S : 1043

S. aculeatissimum Jacq.
Undershrub. Pan-tropical weed of disturbance. Very localised
to locally ff. Open parts of kloof forest. Riparian. S : 538

S. bifurcum Hochst.
Soft subwoody slender liane. Ff. in high forest and kloof
forest (especially moister parts). S : 396

S. giganteum Jacq.
Fair-sized shrub. Very localised and infrequent to occ. locally
ff. along margins of high forest and N.E. Mtn. Sourveld. S : 676

S. indicum L.
Suffrutescent forb. Fairly widespread but very infrequently scattered in disturbed places. Possibly introduced. S : 453

S. nodiflorum Jacq.
Suffrutescent herb. Very localised and infrequent weed of disturbance. S : 281

S. panduraeforme E.Mey.
Subwoody herb. Widespread weed of disturbance. Locally ff. S : 124

*S. seaforthianum Andr.
Subwoody slender twiner. Garden escape from South America. Very localised. Especially in Low Country. S : 265

Solanum sp., cf. S. acanthoideum E.Mey. ex Dun.
Straggling shrub. Very localised and rr. Occ. locally ff. ruderal in Mistbelt. S : 648

SCROPHULARIACEAE

Nemesia capensis (Thunb.) Kuntze
Small bushy herb. Locally ff. to c. in secondary psammosere, Low Country. Localised. S : 769

Diclis reptans Benth.
Small herb. Infrequent in early stages of hydrosere. S : 463

Halleria lucida L.
Widespread small tree. L.S.B.T. river valleys to high forest. S : 512

Sutera accrescens Hiern
Suffrutescent forb. Localised and infrequent. In disturbed retarded lithoseral scrubby grassveld, Mistbelt. S : 998

S. floribunda (Benth.) Kuntze
Lax suffrutescent forb. Rather localised and infrequent. In disturbed scrubby grassveld in Mistbelt. S : 939

Zaluzianskya maritima Walp.
Slender forb. Localised and infrequent in disturbed lithoseral scrubby sour grassveld in Mistbelt. S : 957

Craterostigma wilmsii Engl. ex Diels
Small rosette-forming herb of rock mat formation, Mistbelt. S : 1083

Ilysanthes dubia (L.) Barnh.
Small herb. Infrequent pioneer of wet rock and alluvium. S : 449

Hebenstreitia comosa Hochst.
Lax suffrutescent forb. Rather infrequent in scrubby grassveld and scrub in Mistbelt. S : 425

Selago elata Rolfe
Lax suffrutescent forb of Mistbelt grassveld, especially N.E. Mtn. Sourveld. Infrequent to occ. locally ff. S : 544

S. natalensis Rolfe
Small subwoody forb of Mistbelt grassveld. Infrequent to occ. locally ff. in N.E. Mtn. Sourveld. S : 655

Alectra orobanchoides Benth.
Leafless herb holoparasitic on roots, especially of Acanthaceae, in river-valley scrub, scrub forest and gallery forest. S : 235

A. sessiliflora (Vahl) Kuntze
Herb of pioneer subseral communities; hemiparasitic on roots, especially of weeds. S : 938

Buchnera brevibractealis Hiern
Rr. to infrequent forb in N.E. Mtn. Sourveld. S : 1030

Cycnium adonense E.Mey.
Low subwoody forb. Localised. Infrequent to locally ff. in N.E. Mtn. Sourveld. S : 1025

Striga asiatica (L.) Kuntze
Small herb. Associated with and hemiparasitic on grass. Localised, infrequent. In retarded grassveld, Low Country. S : 529

S.bilabiata (Thunb.) Kuntze
Small hemiparasitic herb. Very localised and infrequent. Associated with grasses in retarded grassveld, Low Country. S : 1048

Harveya coccinea Schltr.
Widespread parasitic herb. Localised, locally frequent. L.S.B.T. riverine scrub to N.E. Mtn. Sourveld and scrub. S : 841

H. speciosa Bernh.
Rr. parasite. Occasionally in Mistbelt scrub. S : 867

BIGNONIACEAE

*Doxantha unguis-cati (L.) Rehd.
Exotic liane. Garden escape. Occ. in plantations. S : 52

PEDALIACEAE

Sesamum alatum Thonn.
Herb. Very localised ruderal of disturbed secondary psammosere, L.S.B.T. Locally ff. S : 837

Ceratotheca triloba E.Mey. ex Bernh.
Widespread tall herbaceous plant of disturbed soil in open. S : 11

GESNERIACEAE

Streptocarpus parviflorus Hook.f.
Small tufted herb. Rather localised to locally ff. Facultative epiphytes, also on rocks and occ. on high-forest floor. S : 103

LENTIBULARIACEAE

Utricularia livida E.Mey.
Small, delicate insectivorous herb. Very localised and infrequent to occ. locally ff. On seepages, Ramadiepa River banks, L.S.B.T. S : 705

U. prehensilis E.Mey.
Small insectivorous herb. Very localised and rr. On seepages, Ramadiepa River bank, L.S.B.T. S : 1173

ACANTHACEAE

Thunbergia alata Boj. ex Sims
Soft slender perennial twiner. Rather localised, infrequent to occ. locally ff. in open to scrubby riverine vegetation and gallery forest.
S : 29, 49

T. atriplicifolia E.Mey.
Subwoody perennial forb. Fairly widespread. Rather localised and infrequent to locally ff. in fire-retarded grassveld vegetation. S : 850

T. natalensis Hook.
Slender subwoody forb. Fairly widespread. Rather localised and infrequent to occ. locally ff., retarded grassveld in Mistbelt, forest margins, scrub forest and gallery forest. S : 1033

Phaulopsis imbricata (Forsk.) Sweet
Widespread undershrub of gallery forest, scrub and scrub forest. Locally ff. to subdominant or dominant in undergrowth. S : 304

Chaetacanthus setiger (Pers.) Lindau
Small suffrutex of disturbed, retarded seral grassveld. S : 698

Crabbea hirsuta Harv.
Low subwoody forb of disturbed and seral sites. S : 120

Sclerochiton harveyanus Nees
Sprawling to subscandent shrub. Rather localised to locally ff. to abundant in high-forest undergrowth and Mistbelt stream-banks. S : 1088

Crossandra greenstockii S.Moore
Subwoody herb of undergrowth and disturbed open situations. S : 517

Dicliptera clinopodia Nees
Localised to locally common undershrub in gallery forest in particular and (riverine) forest. S : 255,450

Hypoestes aristata R.Br.
Infrequent. Undershrub of sour grassveld and scrub especially in Mistbelt. Keet : 1725; S : 656

H. phaylopsoides S.Moore
Rr. Small undershrub of moist, disturbed open places in forest. S : 617

H. verticillaris R.Br.
Locally abundant small undershrub of moister parts of forest. S : 435

Mackaya bella Harv.
Shrub. Infrequent to ff. in more open parts of high forest and riverine (to gallery) forest. S : 478

Isoglossa cooperi C.B.Cl.
Subscandent undershrub in high forest. Localised. S : 599

I. delicatula C.B.Cl.
Locally abundant, spreading undershrub in high forest. Flowers periodically every decade. S : 612

Justicia anagalloides T.Anders.
Widespread low-spreading forb in Low Country and Mistbelt, especially disturbed retarded sour grassveld. S : 717

J. campylostemon T.Anders.
Localised soft shrub of high-forest undergrowth. S : 924

J. cheiranthifolia C.B.Cl.
Perennial undershrub of disturbed, broken and scrubby grassveld. Widespread. S : 510,945

J. protracta (Nees) T.Anders. forma
Undershrub of mesoclinal lithosere, Mistbelt. Localised. S : 430

PLANTAGINACEAE

*Plantago lanceolata L.
Introduced weed of disturbance. Very infrequent to locally common. Localised. S : 902

RUBIACEAE

Oldenlandia affinis (Roem. et Schult.) DC.
Low, repent perennial herb forming extensive mats. Localised especially in disturbed and subseral grassveld. S : 21

O. caespitosa Hiern
Small herb. Very infrequent weed of disturbance here. S : 264

O. goreënsis (DC.) Summerhayes
Forb with lax to trailing stems in hygrophytic grasses and sedges on saturated soil. Very localised. S : 709

O. herbacea (L.) Roxb.
Small forb in disturbed and retarded grassveld. Very localised in Low Country. S : s.n.

O. lancifolia (Schum.) DC.
Lax to trailing forb amongst grasses and sedges, seepages, stream and river banks. Very localised. S : s.n.

Kohautia amatymbica Eckl. et Zeyh.
Small forb of N.E. Mtn. Sourveld. Locally ff. S : 757

K. lasiocarpa Klotzsch
Very localised. Sprawling weedy forb of disturbed areas, Low Country. S : 629

K. omahekensis (Krause) Brem.
Localised to locally ff. Small forb of disturbed xeroseral grassveld, Low Country. S : 1017

Conostomium natalense (Hochst.) Brem. var. glabrum Brem.
Suffrutescent forb of seral grassveld and scrub. S : 81, 204

Agathisanthemum bojeri Klotzsch
Suffrutescent forb. Infrequent to locally common. Localised, gregarious weed of disturbance. S : 839

Pentas micrantha Bak. subsp. wyliei (N.E.Br.) Verdct.
Small suffrutescent perennial. Very localised and rare. In gallery forest, seral scrub and low scrub forest, Low Country. S : 1078

Adina microcephala (Del.) Hiern var. galpinii (Oliv.) Hiern
Fair-sized tree. Important in hydrosere and climax gallery forest, rocky stream-banks mainly below about 900 m. S : 606,889

Cephalanthus natalensis Oliv.
Woody liane and scrambler of more mesophytic and hygrophytic climax and seral types of forest, scrub forest and gallery forest. S : 371

Rothmannia capensis Thunb.
Rather small to occ. medium-sized understory tree of high forest. Occ. reaches (low) canopy. Infrequent to locally ff. S : 1111

Oxyanthus gerrardii Sond.
Understory tree of high forest. Infrequent to locally ff. S : 653,834

Tricalysia capensis (Meisn.) Sim
Rather small understory tree or shrub. Fairly widespread but rather localised to locally ff, in gallery forest and especially high forest. S : 479

Pentanisia angustifolia (Hochst.) Hochst.
Low bushy forb with perennial woody rootstock. Especially in retarded grassveld, Low Country. S : 489

P. prunelloides (Klotzsch ex Eckl. et Zeyh.) Walp.
Low forb with perennial woody rootstock. Especially in retarded N.E. Mtn. Sourveld. S : 476

Vangueria infausta Burch.
Variable small tree. Fairly widespread but rather localised, infrequent. Especially in Mistbelt lithosere, early and late stages. S : 1054

Canthium gueinzii Sond.
Stout woody liane of high forest, forest margins and gallery forest. S : 362,813

C. huillense Hiern
Important pioneer of montane scrub in N.E. Mtn. Sourveld, forest margins etc. S : 691

C. inerme (L.f.) Kuntze
Shrub or small tree in open or undergrowth. S : 852

C. obovatum Klotzsch
Small to medium-sized tree of high forest margin. S : 1077

Pachystigma venosum Hochst.
Low spreading subwoody perennial forb of retarded sour grassveld. Widespread but localised to locally ff. S : 1036

Fadogia monticola Robyns
Widespread locally ff. forb in retarded xeroseral grassveld. S : 486

Pavetta barbertonensis Brem.
Shrub of Scrub Forest Belt especially near streams. Rr. Keet : 1742; S : 539

P. eylesii S.Moore
Small shrubby plants in scrub, L.S.B.T. lithosere. Very localised and infrequent. S : s.n.

P. lanceolata Eckl.
Small tree of high-forest margin, and forest precursor in N.E. Mtn. Sourveld glade. Very localised and infrequent. S : 1063

Psychotria capensis (Eckl.) Vatke [= Grumilea capensis Sond.]
Shrub or small tree of margin or understory, high forest. Infrequent to locally ff. S : 819

Galopina aspera (Eckl. et Zeyh.) Sond.
Widespread suffrutescent perennial herb of retarded grassveld. S : 1101

G. circaeoides Thunb.
Low suffrutescent herb of undergrowth in forest and scrub forest. S : 548

Anthospermum ammanioides S.Moore
Ericoid shrub important in lithosere in High Forest Belt. S : 851

A. herbaceum L.f.
Widespread herbaceous suffrutescent perennial. S : 336,366

Otiophora cupheoides N.E.Br.
Low spreading shrublet forming cushions. Localised chasmophyte of lithosere in High Forest Belt. Locally ff. S : 846

*Richardia brasiliensis Gomez
Widespread low herb. Naturalised weed of disturbance. S : 48

Borreria scabra (Schumach. et Thonn.) K.Schum.
Weed of disturbance especially in Low Country. S : 140,180

Rubia cordifolia L.
Herbaceous perennial creeper. Widespread but infrequent weed especially of disturbed sites. S : 664,973

VALERIANACEAE

Valeriana capensis Thunb.
Perennial forb. Very localised, infrequent. Adventive on disturbed sites, N.E. Mtn. Sourveld. S : s.n.

DIPSACACEAE

Scabiosa columbaria L.
Widespread perennial herb. Rather localised to occ. locally ff., especially on disturbed sites. S : 254

CUCURBITACEAE

Oreosyce subsericea (Hook.f.) A.Meeuse
Small soft tendril-climber. Rare in Scrub Forest and High Forest Belts. S : s.n.

Melothria cordata (Thunb.) Cogn. sens. lat. [= M. punctata (Thunb.) Cogn.]
Widespread soft climber. Rather localised, especially near streams. S : 98, 303, 649

Momordica foetida Schumach. et Thonn.
Widespread creeper especially in Low Country. Very infrequent to occ. ff. Sometimes cultivated by Bantu for a spinach. S : 593;898

Cucumis sp.
Widespread herbaceous creeper, especially in early stages of succession. S : 901

Cucumis sp., cf. C. quintanilhae R. et A.Fernandes (= S : 901?)
Herbaceous creeper. Apparently localised and rr. weed of disturbance, N.E. Mtn. Sourveld glade. S : 1120

Trochomeria hookeri Harv.
Slender soft climber. Rather localised and infrequently scattered in mesophytic scrub and scrub forest, especially near water, Low Country. S : 523

Coccinia adoensis (A.Rich.) Cogn.
Herbaceous climber in seral grassveld and scrub. S : 113

C. variifolia A.Meeuse
Soft climber of openings in Mistbelt high forest. S : 1110

CAMPANULACEAE

Wahlenbergia banksiana A.DC.
Suffrutescent forb. Widespread but rather localised, infrequent to locally ff. on disturbed sites, especially in Low Country. S: 163,1072

W. madagascariensis A.DC. [= W. oppositifolia A.DC.]
Slender, low spreading herb. Rather localised. Especially on disturbed sites in Mistbelt. S : 1191

W. undulata (Thunb.) A.DC.
Subwoody lax forb. Rather localised. Especially on disturbed sites in Low Country. S : 1202

W. virgata Engl.
Virgate bushy forb. Widespread, infrequent to occ. locally ff. in disturbed sourveld. S : 492

Cyphia assimilis Sond.
Widely scattered herbaceous twiner in seral grassveld. S : 22

C. elata Harv.
Widely scattered grassveld forb in Mistbelt and Low Country. S : 272,299

C. transvaalensis Phill.
Rather localised and infrequent herbaceous twiner of mesoclinal lithoseral scrubby grassveld and scrub, Mistbelt. S : 865

Lobelia decipiens Sond.
Small herb. Very localised. Locally abundant pioneer on bare soil in wet places. S : 509

L. erinus L.
Herb. Rr. and localised, locally common on disturbed sites, (Marginal) Mistbelt. S : 1112

L. flaccida (Presl) A.DC. var. scabripes (Presl) E.Wimm.
Small herb. Rather localised. N.E. Mtn. Sourveld glades, top of Escarpment. S : s.n.

L. graciliflora E.Wimm.
Fair-sized perennial herb. Localised. Locally ff. in disturbed N.E. Mtn. Sourveld, Montane Belt to Marginal-Mistbelt transition zone. S : 1044

L. mossiana R. Good
Small herb. Rather localised to locally frequent in disturbed places, N.E. Mtn. Sourveld. S : 981

Monopsis stellarioides (Presl) Urb.
Small trailing herb on moist, alluvial banks along streams. Very localised. S : 259

COMPOSITAE

Ethulia conyzoides L.
Waterside herb. Localised and very infrequent, especially in Low Country. S : 288

Erlangea laxa (N.E.Br.) S.Moore
Widespread to locally common weed of disturbance, especially in Low Country. S : 274

Vernonia ampla O.Hoffm.
Robust variable-sized shrub. Widespread. Locally ff. to common. Important in succession: most stages. S : 335

V. cinerea Less.
Robust erect herb. Very localised and rr. Weed of disturbance in Low Country. S : 634

V. colorata (Willd.) Drake
Fairly robust shrub. Localised and infrequent to occ. locally ff. in disturbed grassveld and scrubby sites, L.S.B.T. S : 1213

V. corymbosa Less.
Small shrub. Widespread but rather infrequent to occ. locally ff. in scrubby grassveld to scrub, especially mesophytic or Mistbelt sites. S : 1137

V. crataegifolia Hutch.
Fairly robust shrub. Very localised and infrequent. Especially in disturbed scrubby sites, L.S.B.T. S : 292

V. fastigiata Oliv. et Hiern
Suffrutescent herb. Rather localised, infrequent to occ. locally ff. weed of disturbance especially in Low Country. S : 632

V. hirsuta Sch. Bip.
Subwoody forb. Widespread but rather localised and infrequent, especially in disturbed grassveld and scrub. S : 326

V. mespilifolia Less.
Robust woody liane. Localised and infrequent. In high forest and kloof forest, in Mistbelt. S : 1105

V. monocephala Harv.
Low, tufted subwoody forb. Very localised chasmophyte in lithoseral (summit) N.E. Mtn. Sourveld. S : 1066

V. natalensis Sch. Bip.
Tufted subwoody forb. Widespread but rather localised to locally ff. on disturbed and fire-retarded grassveld sites especially in Low Country. S : 504

V. oligocephala (DC.) Sch. Bip. ex Walp.
Tufted subwoody forb. Widespread but rather localised to occ. locally ff. on disturbed and fire-retarded grassveld sites especially in Low Country. S : 501

V. shirensis Oliv. et Hiern
Rather small shrubby sp. Widespread. Locally ff. in grassveld and scrubby seral sites. S : 129

V. umbratica Oberm.
Rather shrubby sp. Rather localised, infrequent to occ. locally ff. in shrub layer of high forest. S : 441

Vernonia sp., aff. V. monocephala Harv.
Subwoody forb. Localised but locally ff. to c. in disturbed (and lithoseral)(summit) N.E. Mtn. Sourveld. S : 1022

Adenostemma perottetii DC.
Herb. Widespread but localised to occ. locally ff. pioneer in hydrosere and hygrophyte. S : 97, 289

*Ageratum conyzoides L.
Variable herb. Pan-tropical escape from cultivation and weed of disturbance. S : 46, 460

Eupatorium africanum Oliv. et Hiern
Widespread herb, especially of disturbed grassveld. S : 690

*E. rugosum Houtt. ex descr.
Garden escape. Weed of disturbed, shady and especially moist sites. S : 461

Mikania cordata (Burm.f.) Robins.
Twining liane. Especially in moister spots in scrub forest and various forest types, especially in Mistbelt. S : 452

Mikaniopsis sp.
Liane climbing by means of twisting petioles. Infrequently scattered in high forest. S : s.n.

Dichrocephala integrifolia (L.f.) Kuntze
Weed of disturbed sites (especially moist). S : 403

Aster muricatus Less.
Low perennial herbaceous bush. Localised in retarded grassveld. S : 969

A. peglerae H.Bol.
Perennial herb. Infrequently scattered to locally ff., and gregarious in grassveld and scrub especially in Mistbelt. S : 875

*Erigeron floribundus (H.B.K.) Sch. Bip.
Widespread introduced temperate weed of disturbance. S : 20

Nidorella auriculata DC.
Robust, herbaceous bush. Common weed of disturbance and secondary grassveld. Widespread. S : 194,282

N. resedifolia DC.
Infrequent. Weed of disturbance and cultivation, Low Country. S : 88

Conyza aegyptiaca (L.) Ait.
Tall herbaceous weed of disturbance. S : 1079

C. hochstetteri Sch. Bip.
Waterside herb in better-lit situations. S : 459

C. ivaefolia Less.
Spreading small shrub growing in moist places. S : 342,417

C. persicaefolia (Benth.) Oliv. et Hiern
Fairly large herbaceous weed of disturbance. S : 390

C. pinnata (L.f.) Kuntze
Variable widespread grassveld forb and weed of disturbance. S : 89,1090

C. ulmifolia (Burm.) O.Ktze.
Variable widespread forb. Wide ecological amplitude. S : 524,780

Brachylaena transvaalensis Phill. et Schweick.
Fair-sized tree of high forest, scrub forest and forest margin. Forest precursor. S : 692

Blumea lacera DC.
Small herb of early seral stages. Weed of disturbance especially in moist places in Low Country. S : 708

Laggera alata Sch. Bip.
Widespread weed of disturbed sites in Low Country. S : 372

L. pterodonta Sch. Bip.
Weed of disturbed sites in Low Country. S : s.n.

*?Gnaphalium luteo-album L.
Small herb. Widely distributed weed of disturbance. Cosmopolitan. Probably exotic. S : 370

G. purpureum L.
Small herb. Widespread weed of disturbance. Pan-tropical and sub-tropical. S : 369

G. undulatum L.
Subwoody herb. Widespread weed of disturbance. S : 563

Cassinia phylicaefolia (DC.) J.M.Wood
Suffruticose forb of N.E. Mtn. Sourveld. S : 652

Helichrysum acutatum DC.
Low subwoody forb. Infrequently scattered in N.E. Mtn. Sourveld. S : 678

H. adscendens (Thunb.) Less.
Herbaceous perennial. Especially disturbed sites in Mistbelt scrubby grassveld. S : 854,927

H. appendiculatum (L.f.) Less.
Small herb. Localised. Gregarious in grassveld in shallow sandy soil. River-Valley Variant of L.S.B.T. xerosere. S : 761

H. argyrosphaerum DC.
Widespread weed of cultivation and disturbance. Rr. and localised here. Especially in Low Country. S : s.n.

H. aureonitens Sch. Bip.
Small herb. Locally abundant in disturbed N.E. Mtn. Sourveld. S : 747

H. chrysargyrum Moeser
Lax suffrutex. Locally ff. in disturbed/scrubby Mistbelt (lithoseral) grassveld. S : 930

H. fulgidum (L.) Willd. var. monocephalum DC.
Small subwoody forb. Especially disturbed/over- or selectively grazed N.E. Mtn. Sourveld. S: 483,1010

H. kraussii Sch. Bip.
Ericoid suffrutex. Adventive in secondary psammosere, L.S.B.T. S : 1000

H. latifolium (Thunb.) Less.
Small subwoody forb. Widespread, rather localised: disturbed grassveld, especially fire-retarded. S : 1011

H. lepidissimum S.Moore
Suffruticose forb of seral (especially rocky) grassveld,
Mistbelt. S : 442,988

H. miconiaefolium DC.
Small subwoody forb. Infrequent in N.E. Mtn. Sourveld. S : 817

H. mundii Harv.
Robust subwoody herb. Widespread but localised and rr. to occ.
locally ff. and gregarious in early stages of hydrosere. S : 607

H. nudifolium (L.) Less. var. quinquenerve (Thunb.) Moeser
Widespread subwoody herb. Often ff. to c. to a. in earlier stages
of succession, especially secondary grassveld. S : 525

H. odoratissimum (L.) Less.
Low-spreading, large subwoody dense bush, important invader of
Mistbelt grassveld and subseres. S : 393

H. panduratum O.Hoffm.
Sprawling suffruticose forb. Fairly widespread in earlier stages of
succession (especially secondary) except at higher altitudes. S : 1172

H. platypterum DC.
Localised to locally ff. and gregarious robust perennial forb
of Mistbelt grassveld. S : 911

H. polycladum Klatt
Small subwoody bushy forb. Rather localised in early
Mistbelt xerosere and subsere. S : 920,1122

H. setosum Harv.
Variable suffruticose forb. Lax form with yellow heads more
frequent and widespread. Shrubby form with straw-coloured bracts
infrequent in Mistbelt. S : 278,623

H. splendidum (Thunb.) Less.
Low spreading large (sub-)woody dense bush, occ. invading
grassveld, especially in Mistbelt. S : 710

H. stenopterum DC.
Localised and rr. lax suffruticose forb of hydroseral grassland. S : 307

H. umbraculigerum Less.
Lax soft subwoody forb, infrequent to locally ff. in seral
grassveld especially in Mistbelt. S : 105

H. undatum (Thunb.) Less.
Rr. and localised subwoody forb of Mistbelt grassveld. S : 1056

H. undatum (Thunb.) Less. var. agrostephilum (Klatt) Moeser
Rr. and localised subwoody forb of N.E. Mtn. Sourveld. S : 884

H. wilmsii Moeser
Ornamental low suffruticose forb of (summit) N.E. Mtn.
Sourveld and lithosere. Very rare here. S : 951

H. zeyheri Less.
Very localised low forb of disturbed, secondary psammosere,
L.S.B.T. Very rare here. S : s.n.

Helichrysum sp., cf. H. odoratissimum (L.) Less.
Lax subwoody forb in marshy situations; widespread but
localised, infrequent. S : 620

Stoebe vulgaris Levyns
Spreading ericoid shrub. Rare and very localised. In a small almost pure stand. In open, scrubby mesoclinal lithosere, Mistbelt. S : 733

Athrixia phylicoides DC.
Lax to sub-erect subwoody forb of grassveld and scrub.
Widespread, infrequent to occ. locally ff. S : 321

Inula glomerata Oliv. et Hiern
Robust herb. Widespread African ruderal especially in Low Country. S : 451

I. paniculata (Klatt) Burtt Davy
Herb of swampy areas. Very localised. S : 869

Pulicaria scabra (Thunb.) Druce
Suffruticose herb. Very localised chasmophyte in bedrock of Ramadiepa River bed. S : 704

Callilepis salicifolia Oliv.
Forb of disturbed, retarded and seral grassveld.
Widespread, locally ff. S : 465

*Acanthospermum brasilum Schrank
Low spreading herb. Widespread weed of disturbance.
Now pan-tropical. S : 205

*Xanthium strumarium L. [= X. pungens Wallr.]
Variable-sized short-lived herb. Widespread. Locally ff. to c. on disturbed sites, especially in Low Country. S : 181

*?Siegesbeckia orientalis L.
Suffrutescent forb. Localised to locally ff. in bared and disturbed places, cultivated lands, forest margins. Possibly indigenous weed. S : 70, 314

Aspilia africana (Pers.) C.D. Adams [= Wedelia africana Beauv.]
Suffrutescent subwoody forb. Fairly widespread, scattered to locally ff., especially in disturbed and retarded sour grassveld, Low Country. S : 502

*Tithonia diversifolia A.Gray
Robust short-lived shrubby plant. Pan-tropical garden escape. S : 315

Spilanthes mauritiana (Rich. ex Pers.) DC. [= S. acmella L.]
Low herb. Localised pan-tropical weed of disturbed moist areas. S : 78

*Bidens pilosa L.
Widespread weed characteristic of initial subseral stages. S : 38

*B. pilosa L. var. minor (Blume) Sherff
As typical variety above. S : 191

*Galinsoga parviflora Cav.
Weed of disturbance, especially of moister spots. S : 404

*Schkuhria pinnata (Lam.) O.Ktze.
Very localised and infrequent weed of disturbance. S : s.n.

*Tagetes minuta L.
Widespread but infrequently scattered weed of cultivation and disturbance. S : s.n.

Athanasia punctata Harv.
Tall subwoody forb, locally ff. in scrubby sourveld and scrub, Mistbelt. S : 935

Schistostephium crataegifolium Fenzl
Localised, infrequent forb. Summit N.E. Mtn. Sourveld. S : 968

S. heptalobum (DC.) Oliv. et Hiern
Widespread robust subwoody perennial forb. In grassveld and scrubby vegetation. Locally ff., especially in Mistbelt. S : 261

Artemisia afra Jacq.
Herbaceous perennial. Early xeroseres and subsere. Disturbed seral grassveld. Especially dry situations, Low Country. S : 638

Crassocephalum crepidioides (Benth.) S.Moore
Widespread weed of (moist and) disturbed grassveld especially in Low Country. S : 268, 377, 532

C. picridifolium (DC.) S.Moore
Suffrutescent lax forb of wet places, especially in Low Country. S : 306

Cineraria fruticetorum Hutch. et M.R.F.Tayl.
Lax suffrutex of moist seral and disturbed sites in grassveld and open scrub in Mistbelt. S : 317

Senecio coronatus Harv.
Low forb with perennial rootstock. Localised to occ. locally ff. in N.E. Mtn. Sourveld. S : 759

S. deltoideus Less.
Sprawling or climbing soft liane. Localised to locally ff. in gallery forest, Mistbelt scrub, scrub forest and kloof forest. S : 424

S. erubescens Ait. formae
Widespread very variable forb with perennial rhizome. Various forms rather localised to locally ff. in disturbed and retarded sour grassveld. S : 107, 996, 1008, 1012

S. fibrosus O.Hoffm.
Robust forb from perennial rootstock. Localised to locally ff. in N.E. Mtn. Sourveld. S : 1064

S. inaequidens DC.
Short-lived forb. Fairly widespread but infrequently scattered and localised. On disturbed sites and bare areas. S : 388

S. inornatus DC.
Robust rather short-lived subwoody forb. Widespread but infrequently scattered especially in disturbed grassveld sites. S : 121

S. isatideoides Phill. et C.A.Sm.
Robust forb. Widespread but rather localised to locally ff., gregarious. Especially on disturbed sites. Mistbelt and moister sites, Low Country. S : 876

S. junodii Hutch. et Burtt Davy
Robust forb. Rather localised to locally ff. to common on disturbed grassveld and scrub sites, Mistbelt. Especially in rather bare parts of the High Forest Belt. S : 610

S. orbicularis Sond.
Succulent forb. Widespread but very localised to occ. locally ff. Disturbed grassveld, Low Country and xeroclinal lithosere, Mistbelt. S : 716

S. othonniformis Fourc.
Small succulent forb. Very localised to occ. locally ff.
Pioneer stages of summit lithosere, Mistbelt. S : 847

S. pandurifolius Harv.
Robust forb. Fairly widespread but infrequently scattered,
especially in disturbed and scrubby grassveld, Mistbelt. S : 389

S. pterophorus DC.
Subwoody forb. Widespread, localised to locally ff. weed
of disturbed areas. S : 408

S. sceleratus Schweick.
Widespread forb with perennial rootstock. Rather localised to
locally ff. to abundant weed of disturbed retarded grassveld
especially in Low Country. S : 457

S. serratuloides DC.
Robust forb. Very localised, gregarious. Disturbed, retarded
grassveld, in high forest zone. Rr. here. S : 974

S. speciosus Willd.
Small forb with perennial rhizome. Very localised to locally ff.,
gregarious, in (summit) N.E. Mtn. Sourveld. S : 711

S. tamoides DC.
Succulent twiner. Localised, locally ff. in kloof forest,
Mistbelt. S : 423

Senecio sp., aff. S. purpureus L. (cf. Codd: 7483 & 8421; and Van
der Schijff: 1855; inter alia)
Tall slender forb. Fairly widespread but infrequently scattered.
Especially in disturbed subseral grassveld. S : 193,375

Euryops pedunculatus N.E.Br.
Rather localised subwoody herbaceous forb of retarded rocky
grassveld, mesoclinal lithosere, Mistbelt. S : 994

Osteospermum caulescens Harv.
Small forb. Localised. Locally ff. to c. on disturbed
(summit) N.E. Mtn. Sourveld. S : 482

Gazania krebsiana Less. subsp. serrulata (DC.) Roessl.
Widespread small herb of disturbed grassveld. Infrequent. S : 473

Berkheya insignis (Harv.) Thell.
Small forb in seral and subseral N.E. Mtn. Sourveld. S : s.n.

B. setifera DC.
Forb in N.E. Mtn. Sourveld. Locally ff. to a., gregarious
especially on disturbed areas. S : 836

Dicoma zeyheri Sond.
Perennial forb in seral grassveld and scrub especially in
Low Country. S : 1140

D. macrocephala DC.
Small subwoody forb. Very localised weed of disturbance,
secondary psammoseral grassveld, L.S.B.T. Rr. S : s.n.

Gerbera glandulosa Duemmer
Widespread small rosette forb of disturbed, seral grassveld. S : 503

G. jamesonii H.Bol. ex Hook.f.
Rosette forb of early stages of succession, especially in Low Country. S : 500

G. kraussii Sch. Bip.
Rosette forb of disturbed seral grassveld, especially in Mistbelt. S : 718

G. piloselloides Cass.
Widespread rosette forb of disturbed seral grassveld. Very infrequently scattered, occ. gregarious to locally ff. S : 1094

*Hypochoeris radicata L.
Now cosmopolitan European weed of disturbance. Localised, locally ff. S : 578

*?Sonchus asper (L.) J.Hill
Annual herb. Now cosmopolitan temperate weed. Rather localised and infrequent to locally ff. in moister, shadier disturbed places. Probably exotic. S : s.n.

*?S. oleraceus L.
Annual herb. Now cosmopolitan temperate weed. Widespread and rather infrequent to locally ff. in disturbed places. Probably exotic. S : 313

Lactuca capensis Thunb.
Localised small herb of disturbed sites. Widely distributed African weed. S : 178